26 January 1965

25X1

Contract [redacted] ACTIVE PAR TITLES AND PROPOSED CONDENSED TITLES

PAR	Title	Proposed Condensed Title*
202	Briefing Print Enlarger	Same as title.
203	Rapid Access Printer	Same as title.
206	Reversal Processing of High-Resolution Films Study	[redacted]
207	Definitive Study of Contact Printers	Contact Printer Study
211	Microdensitometer Study of Effects of Processing	Image Effects Study
212	Color Acquisition System Review Study	Color Acquisition Study
213	Color Reproduction Systems Review	Color Duplication Study
214	Roller Transport Reversal Processor (12-Inch)	Reversal Processor RT-12
215	Roller Transport Processor (24-Inch)	Processor RT-24
216	Exposure of Photographic Material with Lasers	Laser Photographic Exposure
217	Optimization of Lasers	Same as title.
222	Stereo Registration Systems	Stereo Registration System
223	Monochromatic Lens System	Monochromatic Lenses
224	7X - 15X Fluid Gate Enlarger	Fluid Gate Enlarger
225	Microdensitometer Training Program	Microdensitometer Training
226	Analysis of Photographic Images to Evaluate System Performance	Photographic Image Analysis

*Condensed titles are to contain a maximum of 30 characters including spaces.

25X1

FY-65 Quarterly Report, No. 4

PAR 206
28 May 65

SUBJECT: Reversal Processing of High Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. Publication of the final report, PAR 206, Reversal Processing of High Resolution Films Study, dated 1 April 1965, constitutes project completion.

PLANNED ACTIVITIES

3. None. Project completed.

SECRET

MONTHLY REPORT

25X1

PAR 206

3 May 65

SUBJECT: Reversal Processing of High Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. Effort on the final report was completed for editing and reorganization. It is now being considered for publication approvals.

PLANNED ACTIVITIES

3. Issue the final report by 28 May 65.

MONTHLY REPORT

[redacted]

25X1

PAR 206
31 Mar 65

SUBJECT: Reversal Processing of High Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. Work was continued on the final report. A draft of the report has been written which includes illustration material summarizing earlier findings with those just lately reported. This material is now undergoing the editing and reorganization effort necessary to submit for approvals and publication.

3. Discussions held with the customer representative on 19 Mar 65 dealt briefly with progress on the final report and more extensively with briefing aids. Customer guidance on these aids is being followed as a separate effort to avoid delay on the final report.

PLANNED ACTIVITIES

4. Issue the final report by 30 April 65.

QUARTERLY REPORT

[redacted]

25X1

PAR 206
26 Feb 65

SUBJECT: Reveral Processing of High Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. The studies have been completed, sufficient data for an evaluation have been collected and the final report is being prepared. Based on the findings, several preliminary general statements can be made about some of the topics which have aroused the most interest. These and others will be discussed in detail in the final report:

a. A second generation duplicate negative, obtained by a reversal process, has a higher resolving power (both high and low contrast) than does a conventional third generation duplicate negative. The magnitude of the relative improvement (lines/millimeter) depends on the original negative film type.

b. Original negative film Types 4400, 4401, 4404 and duplicate film Type 8430 are all satisfactory reversal films. They all possess somewhat the same sensitometric characteristics when reversal processed as when conventionally processed.

c. The chemical re-exposure studies did not produce any improvement in resolving power over tungsten light re-exposure. In addition, this technique creates a potential human safety hazard and requires extreme care to avoid contaminating other photographic products and systems. The final report will recommend it not be used when it can be avoided.

d. An abbreviated experimental series of tests with UV enhancement did not produce better resolution than reversal processing. UV enhance-

ment is a procedure reported in the literature of treating a latent image by subjecting film to an exposure through the base with low intensity ultraviolet light.

e. The most significant relative improvement of resolving power produced by reversal processing was in first generation original positives over conventional second generation duplicate positives. The magnitude of the improvement depends on the original negative film type.

PLANNED ACITVITIES

3. Complete and issue the final report.

MONTHLY REPORT

25X1

PAR 206
22 Jan 65

SUBJECT: Reversal Processing of High Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. The high contrast (12th root of 2, black bar on clear surround and clear bar on black surround) resolving power targets were received. They were examined by the image analysis group and found to be satisfactory for use in this program. Their frequency range is from 84 to 634 lines/mm. The steps are separated by a multiplying factor of 1.06; that is, each step is 6 percent greater in frequency than the step immediately below it. This construction makes the 12th root targets twice as sensitive as the 6th root targets whose steps increase by 12 percent. Samples of all the targets used in the study will be included in the final report.

3. The 12th root of two targets will be reduced onto a special high resolution material for use in a contact printer. In this form, they can be used for a generation series with Type 8430 duplicating film. The 6th root of two targets are already available for this application.

4. Some resolution data, of a preliminary nature, has been collected, but there is nothing conclusive to report at this time. The resolution values obtained appear reasonable and indicate that the tests are proceeding along correct lines.

5. Three proposed designs for briefing aids were prepared for submitting to the customer.

PAR 206

22 Jan 65

PLANNED ACTIVITIES

6. Complete collection and analysis of resolution data.

7. Initiate preparation of final report.

25X1

PAR 206

24 Dec 64

SUBJECT: Reversal Processing of High Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. Final processing conditions were established for film Types 8430, 4400, 4401, and 4404 on the sensitometric processor. These conditions (see Tables 1 and 2) produce the curves shown in Figures 1 through 4. Curves for a negative process, a reversal process with chemical fogging agents and a reversal process with light re-exposure are shown in each figure. The negative process, needed for the resolving power tests, produces sensitometric results identical to one of the contractor's production processes.

3. Because the new resolving power targets (based on a 12th root of 2 multiplying factor) have not been completed, activity on this PAR has been stopped. The targets have been promised for the first week of January 1965 and as soon as they are received the study will be resumed.

PLANNED ACTIVITY

4. The final phase of the study will be devoted entirely to collecting resolving power data. The resolving power tests will establish for each film type and each target polarity the maximum resolution that can be expected for:

a. Negative process.
b. Reversal process - light re-exposure.
c. Reversal process - chemical fogging.
d. Reversal process - either (b) or (c) with UV enhancement.

Stage	Process Temp. °F	Chemical	Time Min. Sec.
Develop:			
8430	71	DD-691	28"
4400	80	P-693	3'30"
4401	80	P-693	3'30"
4404	74	P-693	1'15"
Stop:			
All	Same	SB5B	10"
Fix:			
All	Same	F-6	1'30"

Table 1. Process conditions on the Sensitometric Processor for the negative curves in Figure 1 through 4.

Stage	Chemical at 75°F	Time Min. Sec.
Develop:		
8430	MPB-101D	2'37"
4400	D-94	1'45"
4401	D-94	1'45"
4404	MPB-111D	3'00"
Stop: All	SB5B	15"
Bleach: All	R-9	30"
Rinse: All	H_2O	1'00"
Clear: All	CB-3	30"
Rinse: All	H_2O	1'00"
Re-Expose" All	800-1200 fcs	
R_e-develop: (light re-exposure) All	D-95	1'00"
Re-develop: (chemical fogging) All	FD-68	2'00"
Rinse: All	H_2O	1'00"
Fix: All	F-6	2'00"

Table 2. Process conditions on the Sensitometric Processor for the reversal curves shown in Figures 1 through 4.

Emulsion 8430

SECRET

EXPOSURE

Sensitometer

Exposure Time

PROCESSING

$\log E_{II} = 1.38$

See Tables 1 and 2

Curve	Process Type
1	Reversal - light re-exposure
2	Reversal - chemical fogging
3	Negative

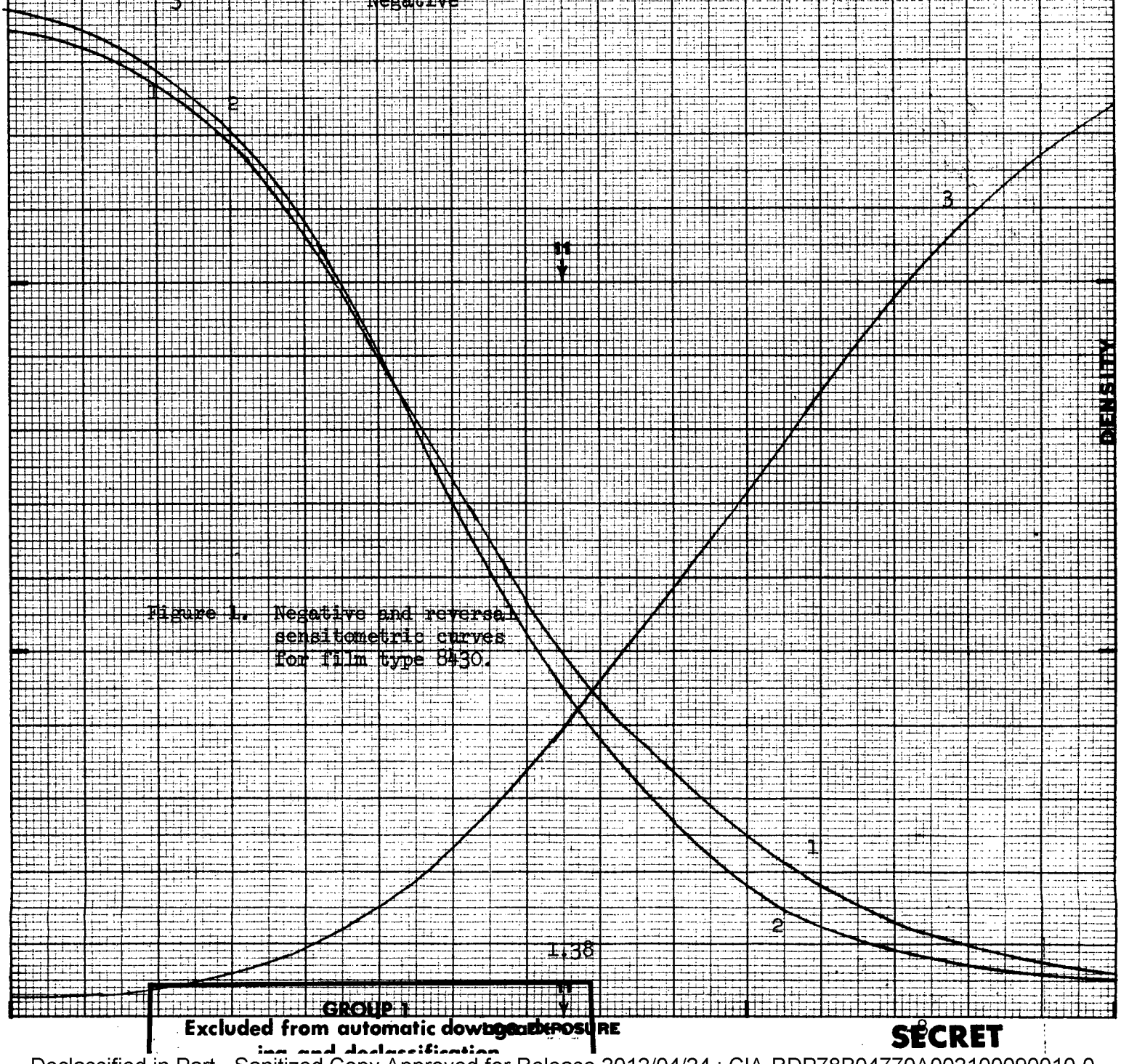

Figure 1. Negative and reversal sensitometric curves for film type 8430.

GROUP 1
Excluded from automatic downgrading and declassification

LOG EXPOSURE

SECRET

24 Dec 04

SECRET

PAR 206

Emulsion 4400

EXPOSURE

Sensitometer

Exposure Time

PROCESSING

$\log E_{11} = 2.70$

See Tables 1 and 2

Curve	Process Type
1	Reversal - light re-exposure
2	Reversal - chemical fogging
3	Negative

DENSITY

3.8 3.6 3.4 3.2 3.0 2.8 2.6 2.4 2.2 2.0 1.8 1.6 1.4 1.2 1.0 .8 .6 .4 .2 0

Figure 2. Negative and reversal sensitometric curves for film type 4400

GROUP 1
Excluded from automatic downgrading

SECRET

Emulsion 4401

EXPOSURE

Sensitometer

Exposure Time

$\log E_{11} = \bar{2}.70$

PROCESSING

See Tables 1 and 2

Curve	Process Type
1	Reversal - light re-exposure
2	Reversal - chemical fogging
3	Negative

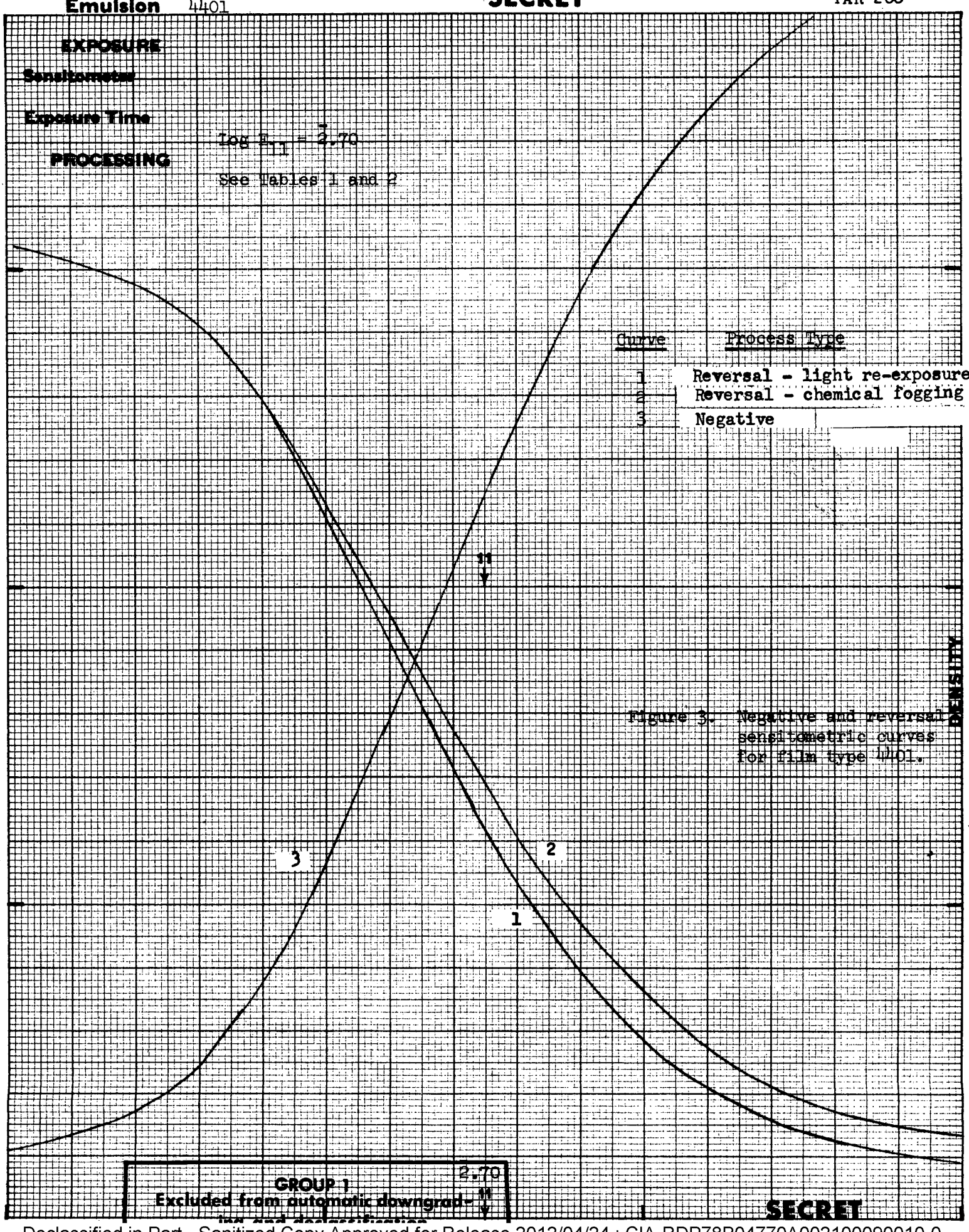

Figure 3. Negative and reversal sensitometric curves for film type 4401.

24 Dec 04

Emulsion 4404

PAR 206

EXPOSURE

Sensitometer

Exposure Time

$\log E_{11} = 1.30$

PROCESSING

See Tables 1 and 2

Curve	Process Type
1	Reversal - light re-exposure
2	Reversal - chemical fogging
3	Negative

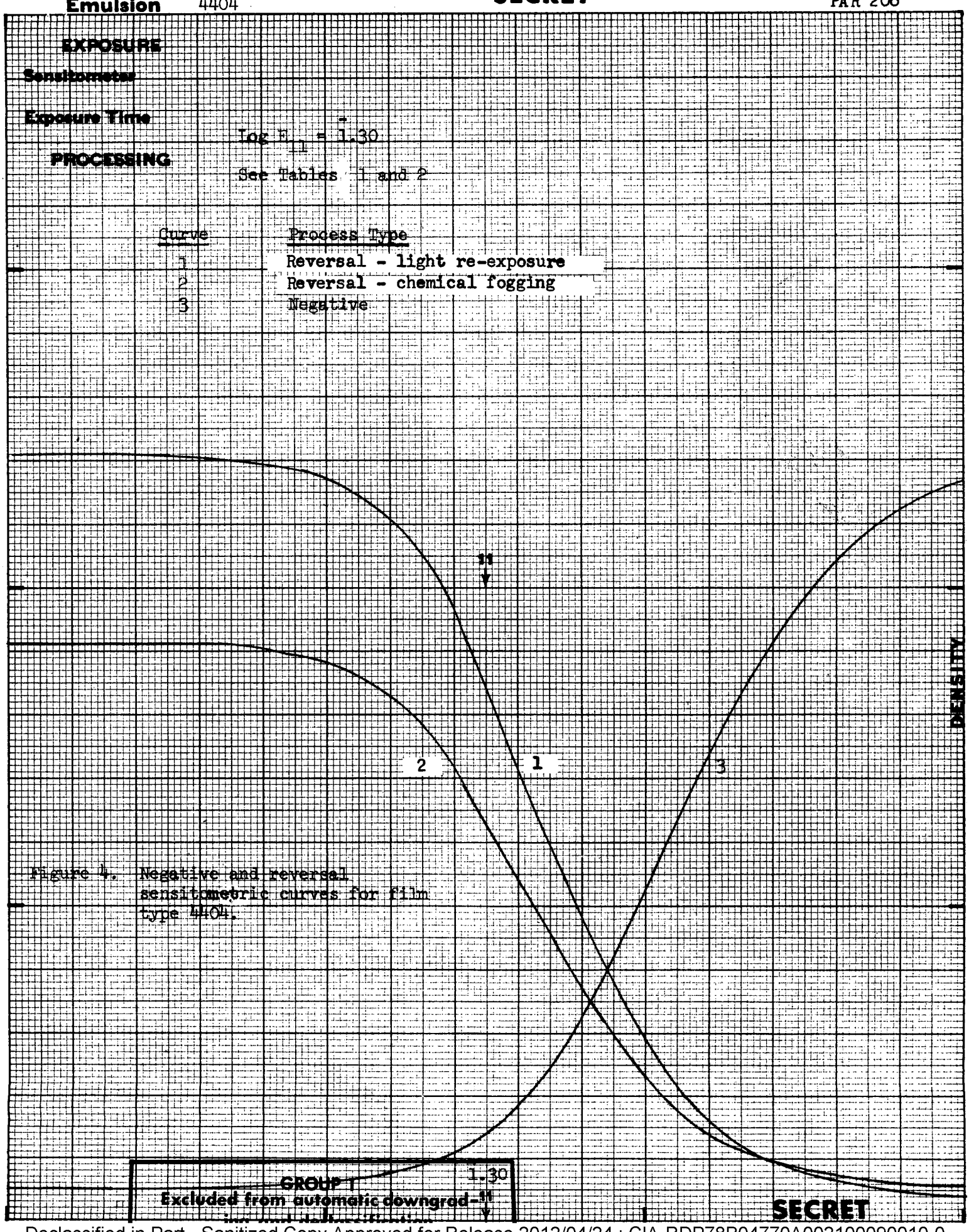

Figure 4. Negative and reversal sensitometric curves for film type 4404.

GROUP 1
Excluded from automatic downgrading and declassification

PAR 206
24 Dec 64

5. In addition, a generation series will be obtained for Type 8430 film. When these data have been collected and analyzed, a final report will be issued.

25X1

PAR 206
30 Nov 64

SUBJECT: Reversal Processing of High Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. Sensitometric Processing

a. Attempts to establish a reversal process for film Type 8430 on a production processor (Grafton) had been unsatisfactory in the past because of a consistent yellow highlight stain and too low a contrast. Since very little was known about the reversal characteristics of this film or any of the others which fitted into the scope of the study, laboratory investigation was performed using a sensitometric processor to collect information which could be used in solving problems of this nature.

b. The sensitometric processor was specifically designed for this type of experimentation. It can accommodate almost any processing cycle, has a small fluid capacity, a wide choice of operating temperatures and agitation rates, and can be operated by one man. Start-up and shut-down times are in the neighborhood of a few minutes while a full scale processor can easily require several hours. It should be noted that since it is an immersion type processor, data obtained with it will always be more closely related to deep-tank than to other types of full-scale processors, but with its use a great deal of insight can be gained into the results that can be produced with any processor.

c. The high-resolution films selected to meet the requirements of the study were:

Film Type No.	Normal Use
4404	Original Negative
4400	Original Negative
8430	Duplicating
SO-233	Duplicating

An attempt was made to establish Plus-X Reversal Film as a control emulsion with which the other films could be compared. This was not successful, however, since the films under investigation needed quite different process times and chemicals.

d. The laboratory program used the conventional reversal processing cycle: develop, stop, bleach, wash, clear, wash, reexpose, redevelop, wash, fix, wash and dry. The first series of experiments involved large changes in processing conditions for all except the wash stages of the cycle. In this way, some of the critical operating conditions were pointed out and used to design experiments for a finer measure of the necessary limitations of operating parameters. This kind of information is needed for production type processors which always have limitations in the amount of change that can be made in the process conditions of each stage. For instance, with a given bleach concentration and temperature, both the minimum and maximum time limits for satisfactory bleaching must be known. Too little bleaching results in a stain (unbleaching) while too much results in a mottled condition (re-reversal).

e. All of the samples of Type SO-233 tested had a yellow highlight stain and mottled condition. Since there appeared to be no quick method of improving the quality and since Film Type 8430 satisfied most of the program requirements for a duplicating film, Type SO-233 was dropped from the investigation.

f. The results with film Types 4404 and 8430 show that almost identical sensitometric results (emulsion speed, contrast, etc.) can be produced in reversal processing as in standard negative processing.

g. Film Type 4400 tolerance to changes in processing conditions is quite different from Types 4404 and 8430, so sensitometric testing with it has been delayed to minimize process changeovers. Enough has been learned, however, to show that no great problems should be encountered in establishing test processing conditions.

3. Full Scale Processing (Grafton)

a. The Grafton processor was used in the program for two weeks. It is a large scale production processor that has been modified to accommodate several different processing cycles. It is a deep tank processor (the first developer can also be converted to a spray chamber). It has automatic temperature control, nitrogen burst agitation, variable film travel speed, and can process all widths of film from 16mm to 9.5 inches. The plumbing between the chemical mix room and the processor is fitted with quick disconnects so the chemicals in any supply tank can be routed to any processing stage of the machine. This versatility allowed the processor to be converted from color processing to black-and-white reversal processing in only two days, including the twenty-four hours needed to decontaminate the system of residual color chemicals. A schematic of the Grafton is shown in Figure 1.

b. The Grafton had two undesirable features which should be remedied:

(1) The clearing bath stage was not followed by a wash.

(2) Only one tank of second development was available, which did not provide sufficient time for the chemical fogging developers. Several unused tanks could be utilized for these purposes if necessary changes are made in recirculation and heating systems.

c. The first developer stage of the Grafton was used as a deep tank rather than a spray system. There were two reasons for this:

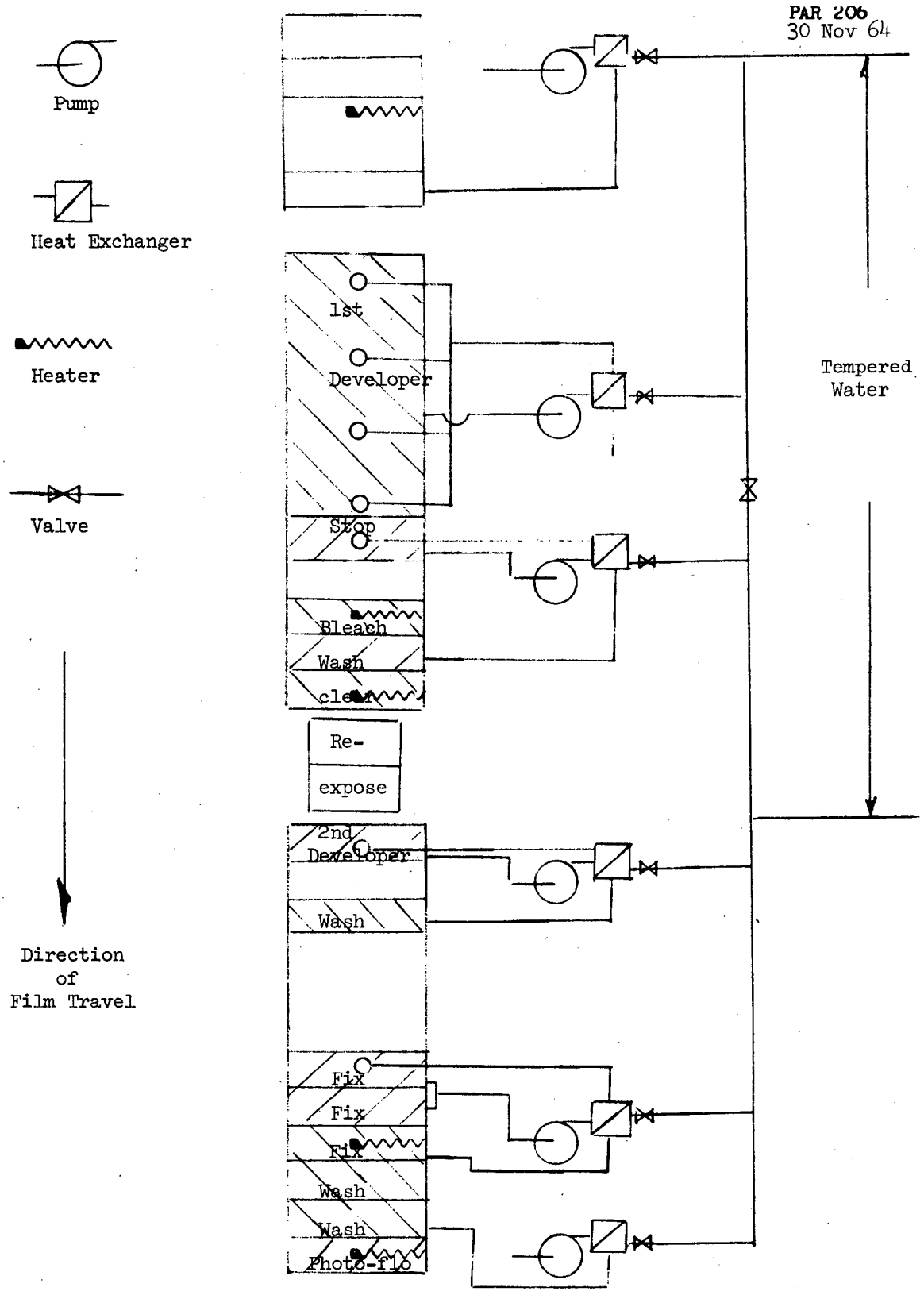

Figure 1. Schematic of Grafton processor. The tanks are labelled to show their use for black and white reversal processing. The unlabelled tanks are not used.

(1) The processing conditions that had been arrived at on the sensitometric processor would produce almost identical results in the deep tank system. This close correlation of effect probably saved at least three days of testing.

(2) The additional conversion time needed to install the spray system, and improve the process uniformity, was not warranted, since for the testing planned, a lower level of uniformity was acceptable. Of course, for extensive processing of high priority imagery, a spray system would be superior.

d. The sensitometric curves for the films processed on the Grafton are included in the report; Figure 2 for Type 8430, Figure 3 for Type 4404 and Figure 4 for Type 4400. The process temperatures, first development time, and first developer are listed in the figures. The remainder of each process was the same for all and is itemized in Table 1. The two curves for film Type 4400 in Figure 4 show the separate effects of visible light reexposure and chemical fogging.

e. A resolving power series was generated with film Type 8430. High contrast, sixth root of two, 80 to 800 l/mm range targets of both polarities were used. The polarities correspond to dark bars on a clear surround and clear bars on a dark surround. The resolution values contained in the master target format and their group codings are listed in Table 2. All first generation printings were made with U.V. light on a vacuum board. The higher generations were printed with a Niagara printer. The processed targets were read independently by several different people. No large differences in the data were found between individuals. The resolution values from the series that first aroused interest in the present study and the values from the latest tests are shown in Figure 5. The original values, denoted "O", were obtained with the clear bar on a dark surround target, and should be compared to the "C" values.

PAR 206

Emulsion 8430 **Date** 30 Nov 64

Experimenter Date Witness Date

EXPOSURE

Sensitometer IB

Filter

Exposure Time Log E_{11} = 1.38

PROCESSING

Gamma	D-min
1.30	.12

75°F process with MPB-101D 1st developer for 2 minutes 30 seconds.
See Table 1 for remainder of process.

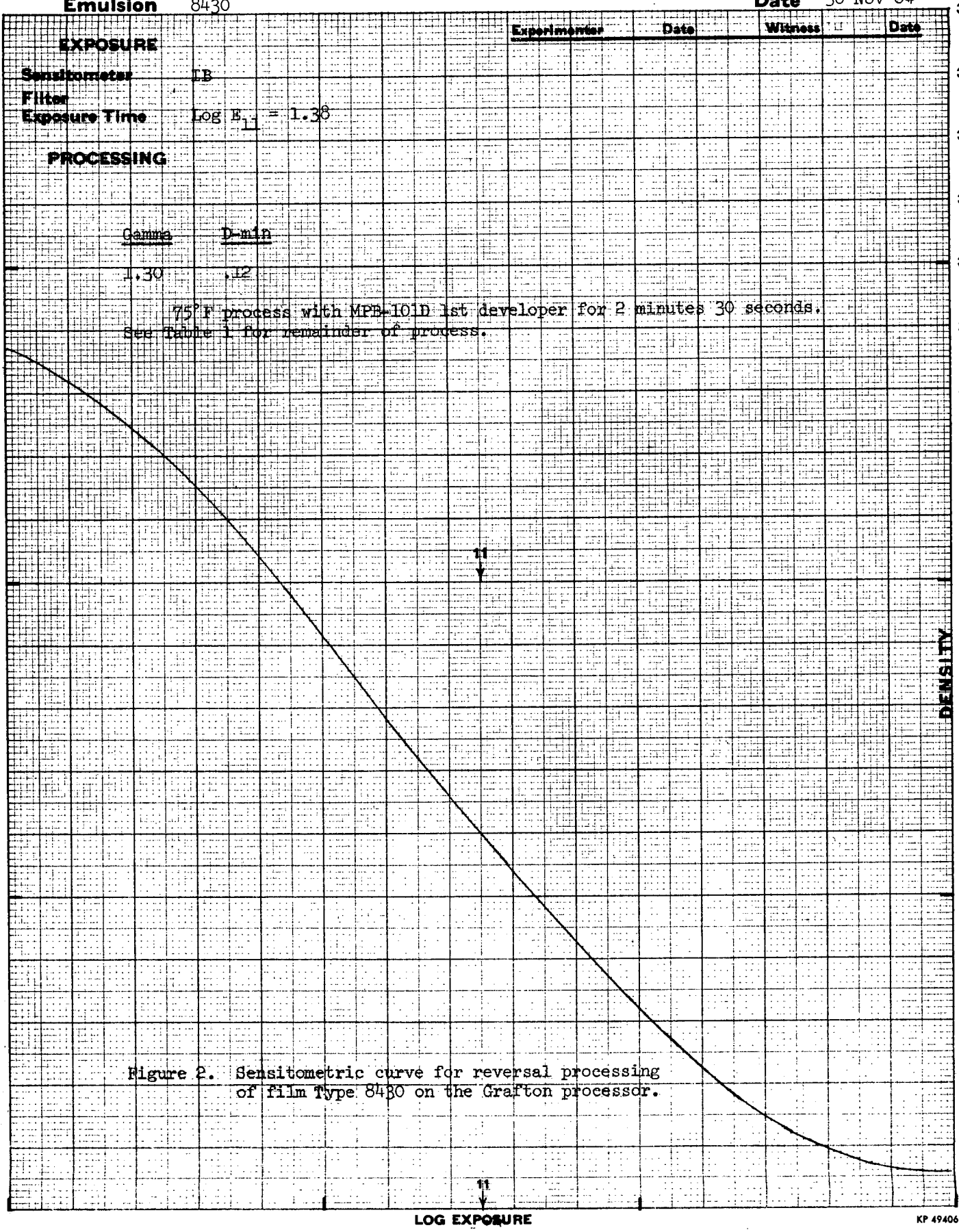

Figure 2. Sensitometric curve for reversal processing of film Type 8430 on the Grafton processor.

GROUP 1
Excluded from automatic downgrading and declassification

PAR 206

Emulsion 4404 **Date** 30 Nov 64

Experimenter	Date	Witness	Date

EXPOSURE

Sensitometer IB
Filter
Exposure Time Log E_{11} = $\bar{1}.30$

PROCESSING

Gamma	0.6G/Speed	D-min
2.30	$\bar{1}.12$	.09

75°F process with MPB-111D 1st developer for 3 minutes.
See Table 1 for remainder of process.

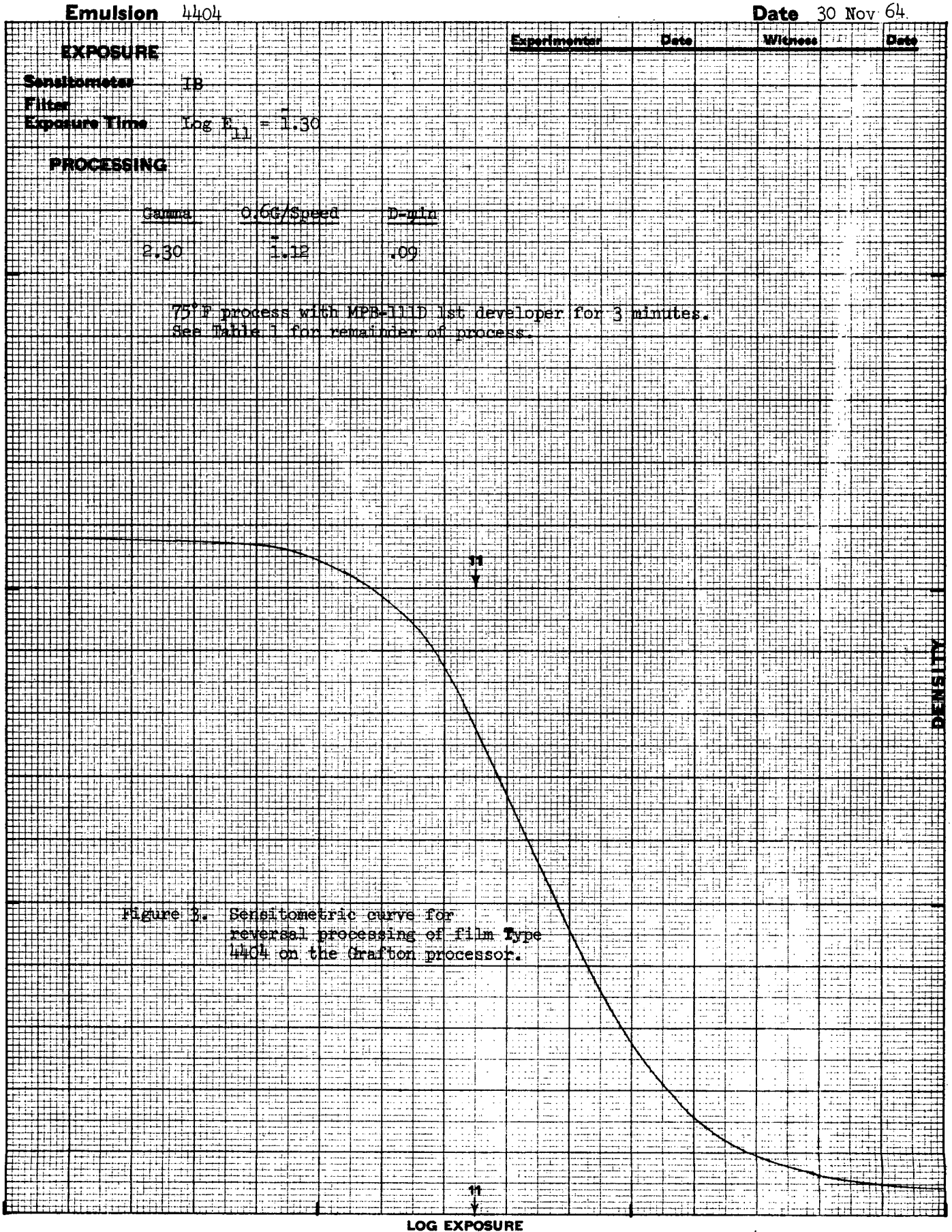

Figure 3. Sensitometric curve for reversal processing of film Type 4404 on the Graflon processor.

GROUP 1
Excluded from automatic downgrading and declassification

PAR 206

Emulsion 4400 **Date** 30 Nov 64

Experimenter Date Witness Date

EXPOSURE

Sensitometer IB

Filter -

Exposure Time $\log E_{11} = 2.70$

PROCESSING

Curve	Gamma	0.6G/Speed	D-min
1	1.45	2.14	.11
2	1.00	3.78	.11

Both curves were produced in a 68° F process with D94 1st developer for 1 minute and 45 seconds. The processing conditions shown in Table 1 were also used except that for Curve 2 a fogging 2nd developer, FD-68 was used instead of visible light re-exposure and D-95 re-developer.

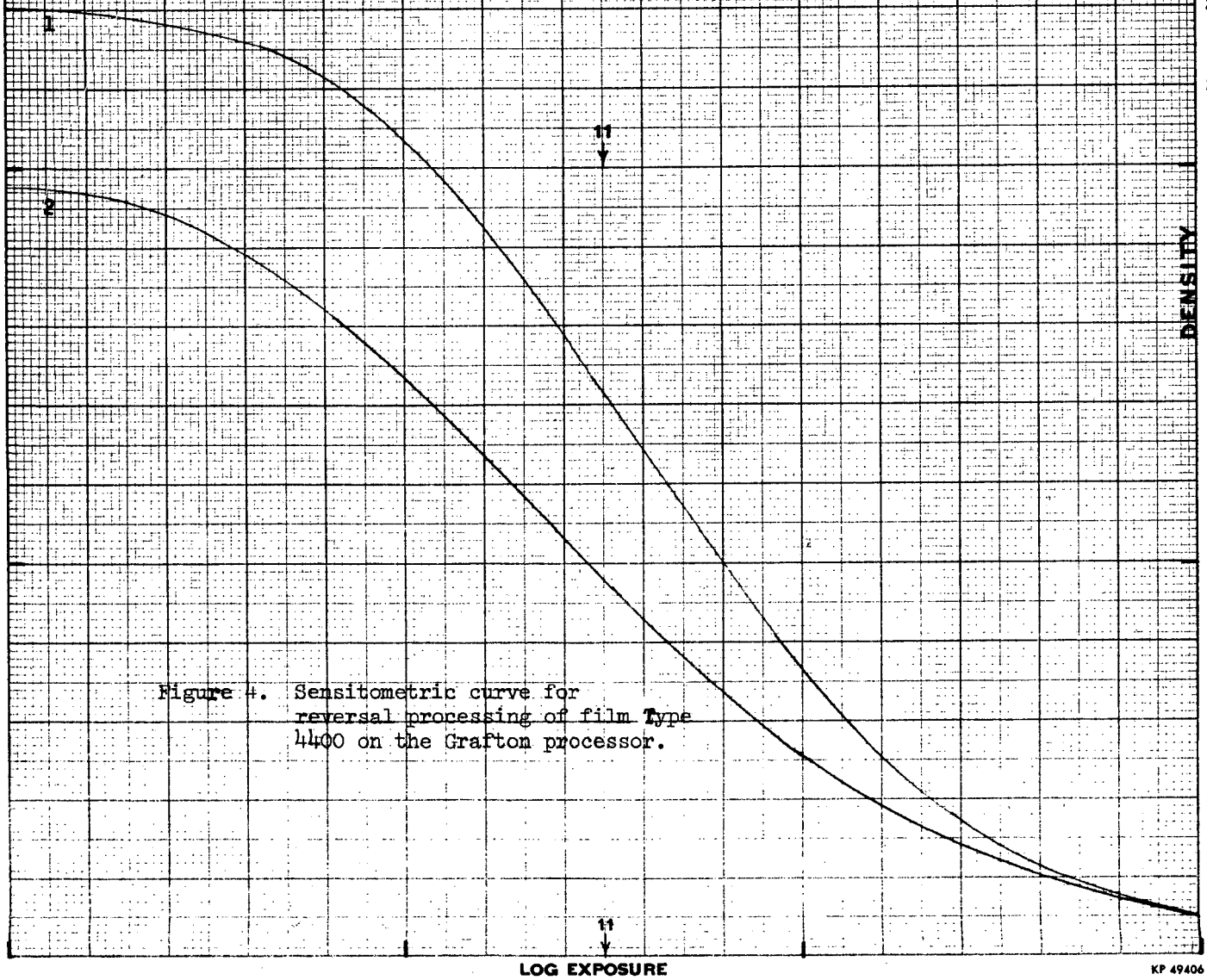

Figure 4. Sensitometric curve for reversal processing of film Type 4400 on the Grafton processor.

Processing Stage	Chemical	Time
Develop	See appropriate Figure	
Stop	SB5B	1'00"
Bleach	R9	1'12"
Wash	Water	1'12"
Clear	CB-3	1'27"
Re-expose	1600 fcs (through base)	--
Re-develop	D95	58"
Wash	Water	1'12"
Fix	F-6	3'40"
Wash	Water	2'28"
Photo-flo	P-F	1'12"

Table 1. Processing conditions on the Grafton for all stages except the 1st developer which produced the curves shown in Figures 2, 3, and 4 for film Types 8430, 4404, and 4400 respectively. The chemical formulas will be included in the final report.

Step Number	Group Number			
	6	7	8	9
1	79.3	158.6	317.0	634.0
2	88.4	176.8	353.6	707.2
3	99.1	198.3	396.3	793.0
4	110.5	221.0	442.0	
5	124.8	249.6	499.2	
6	135.1	278.2	556.4	

Table 2. This table lists the resolving power values in lines per mm contained in the targets used to generate the data shown in Figure 5. The values are usually reported in terms of the Group and Step numbers; e.g. 8/2 in stead of 353.6 l/mm.

PAR 206
30 Nov 64

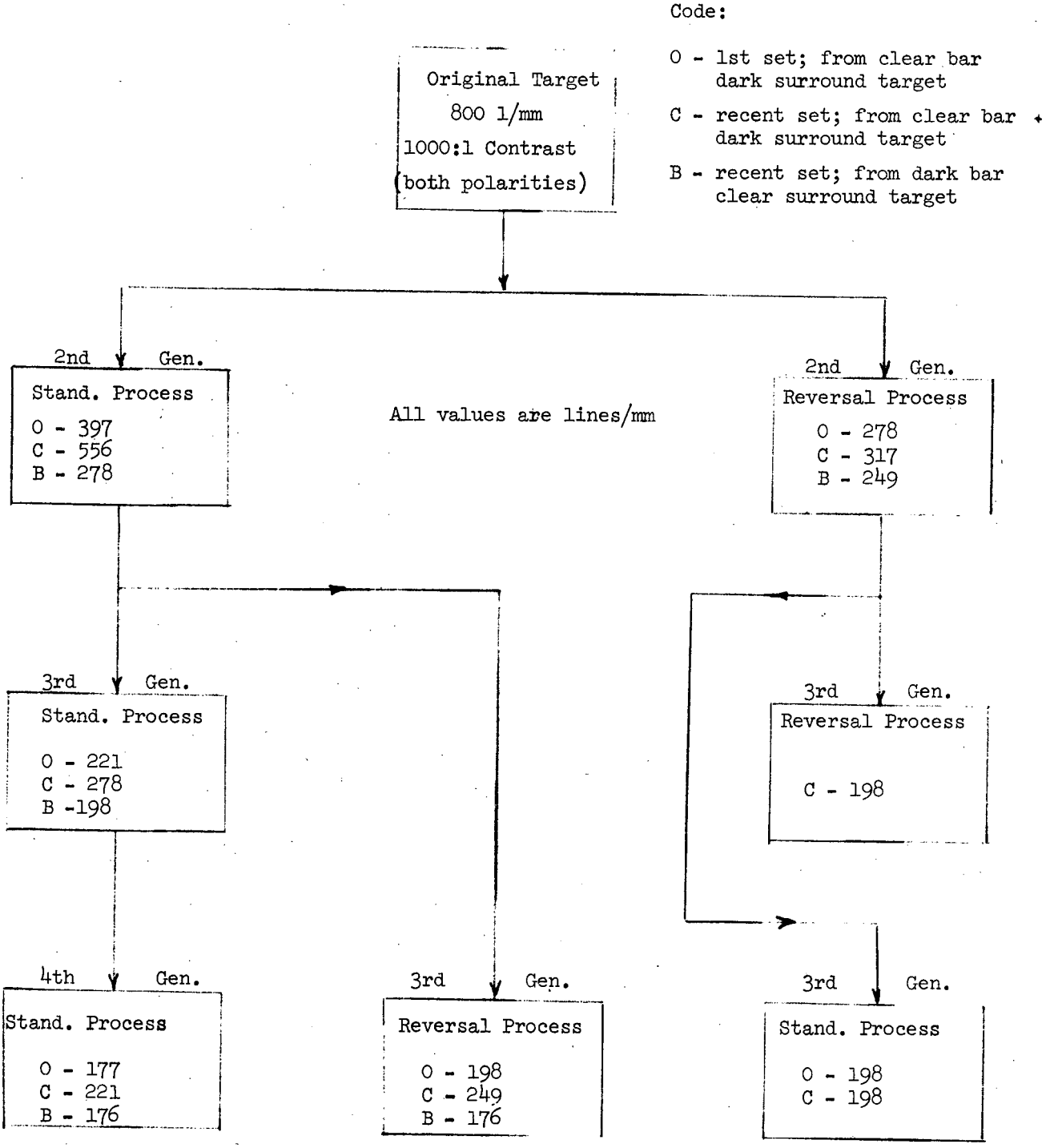

Figure 5. Resolution values obtained with Type 8430 film. The "O" values, the 1st set generated by the study should be compared to the "C" values of the more recent Grafton tests.

f. In all the steps of the series except one, the latest values are higher. This increase might be accounted for by improved printing methods. Most important, however, is the fact that earlier results were confirmed; that is, more information of an original film will be retained in a duplicate negative if it is obtained as a second generation product of a reversal process rather than a third generation product of a standard negative process (corresponds to third and fourth generation comparisons in the test series, Figure 5). The resolution values from the dark bar on a clear surround target were, as expected, much lower than the opposite polarity.

g. A third generation negative copy was made of some typical reconnaissance scenes on 9.5 inch Type 4400 film and was used as a simulated original negative. Part of this was reversal processed with white light reexposure and part with a fogging type second developer. An examination of the sensitometric curves in Figure 4 will show that a lower maximum density was obtained with the chemical reexposure than with light. This was due to insufficient second development time and can be corrected by the suggested changes in the Grafton, Paragraph 3.b.(2).

h. Image material on film Types 8430 and 4404 was processed along with the resolution targets and essentially the same type of generation series was obtained. Some of this material was arranged in transparent folders so the various generation steps could be easily compared. All of the materials demonstrated that satisfactory results can be obtained with film Types 8430 and 4404 and 4400 in terms of tone, contrast, and film speed. Several hundred feet of imagery is on hand and is available for viewing.

i. A complete review of this program was given for the customer representative on 19 November 1964. All of the major steps from its beginning

to its present status were outlined. The resolution data and the image material displayed for viewing gave rise to the major part of the discussions.

PLANNED ACTIVITIES

4. Resolving power experiments are planned for film Types 8430, 4404, and 4400 on the sensitometric processor. The effects to be determined are:

a. Fogging second developers
b. U.V. enhancement
c. Reexposure levels
d. Fine grain developers
e. Bleach times

Targets of both polarities, based on twelfth root of two imcrements, will be used to provide twice the sensitivity of measurement as those used in the past. These targets are being constructed and should be available soon.

5. Tests will be continued to obtain background data needed for potential production operation.

Attachment #4

Misc - 56
21 Nov 64

25X1 SUBJECT: Contract [redacted] Progress Review Meeting, 19 Nov 64 - PAR 206, Reversal Processing of High-Resolution Films

25X1 VISITORS: [redacted]

CONTRACTOR PERSONNEL: [redacted] 25X1

1. A review was made of the program from its first inception through all of the major intermediary phases to its present status. The major areas covered were:

a. The methods used to obtain the first series of resolution data (Ragdoll processor).

b. The conversion and checkout of the Grafton processor.

c. Investigations on the Sensitometric processor.

d. Application of the Sensitometric processor results to the Grafton processor operation.

e. Films processed on the Grafton.

f. Planned activity.

2. Several areas of particular interest to [redacted] were discussed in detail. These are listed below: 25X1

a. Briefing Boards - A relocation and relabelling of some of the descriptive symbols would make them more valuable and descriptive for his use.

b. Grafton Processor - A description of the processor's automatic control features and its adaptability to different processing situations was presented.

c. Resolving Power - Reasons for:

(1) Using targets of both polarities.

(2) Constructing new targets with smaller incremental differences between steps.

GROUP 1
Excluded from automatic downgrading and declassification

Attachment #4

Misc - 56
21 Nov 64

(3) Having several people read the processed targets.

d. Image Material from Recent Grafton Operations - Comparative layouts of the image material were presented.

25X1

3. [redacted] expressed concern about the possibility that the design and fabrication of some pieces of equipment intended for reversal processing use might be progressing at too fast a rate to incorporate important findings from PAR 206 studies.

ACTION ITEM

4. Contractor to revise and relocate some briefing board symbols.

25X1

MONTHLY REPORT

[redacted]

25X1

PAR 206

30 Oct 64

SUBJECT: Reversal Processing of High-Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high-resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. Sensitometric testing was continued to investigate the individual photographic characteristics and special process requirements of films 8430, 4404, 4400 and SO-233 when used as reversal materials. All of the tests were designed to obtain information which would be directly related to the use of these films with the Grafton machine and other conventional types of reversal processing equipment. Processing times, temperatures, and chemicals were kept within the ranges presently considered normal. When the potential of the films has been established within these bounds, more extreme conditions will be tested.

3. Preliminary process conditions have been chosen for film types 4404 and 8430 to be used while investigating:

a. Re-exposure.

b. Second development.

c. Image quality.

4. A reversal process was selected for each film which produces sensitometric results almost identical to those which are achieved with the same film in a standard negative process. This similarity in effect was the only reason for selecting these process conditions which may or may not prove to be optimum for maximizing resolving power or for producing the best tone reproduction.

5. The characteristic reversal process curves for the 4404 and 8430 are shown in Figures 1 and 2 respectively. These figures also show the standard negative curves. Table I lists the important parameters of all the curves and Table II lists the reversal processing conditions. The specification sheets for the negative processes are also included (Specification No. 600, Type 8430; Specification No. 603, Type 4404) in Tables III and IV.

6. The significant sensitometric differences between the reversal and negative processes as shown in Table I are:

a. The 4404 reversal absolute D_{min} is about 0.10 density units lower than the negative.

b. The 8430 reversal requires about 0.80 Log E units less exposure (as measured with 0.6 gamma points) and the absolute D_{min} is about 0.05 density units higher than the negative.

7. Film type 4400 also shows very promising results, but since it has a much heavier emulsion and requires different chemistry than 8430 and 4404, testing with it has been delayed to minimize the process changeovers. Its characteristics seem to be very similar to 7276 (Plus-X Reversal) so less testing should be needed with it than with the others.

8. SO-233 has been dropped from the investigation. An excessive yellow stain and non-uniformity was present in all samples tested.

PLANNED ACTIVITY

9. Material will be prepared for tests on the Grafton machine in the event it is available in the near future. Resolving power, sensitometric, image and chemical tests will be made with all of the films now being investigated.

10. Investigations will be continued on the sensitometric processor.

Emulsion 4404 **Date** 30 Oct 64

Experimenter Date Witness Date

EXPOSURE

Sensitometer IB
Filter Daylight
Exposure Time 1/25 sec.

PROCESSING $\text{Log } E_{.1} = \bar{1}.30$

Reversal

See Table II for processing conditions

Negative

See attached processing Spec. #603 (Full Condition)

O - 0.6 Gamma Speed Points

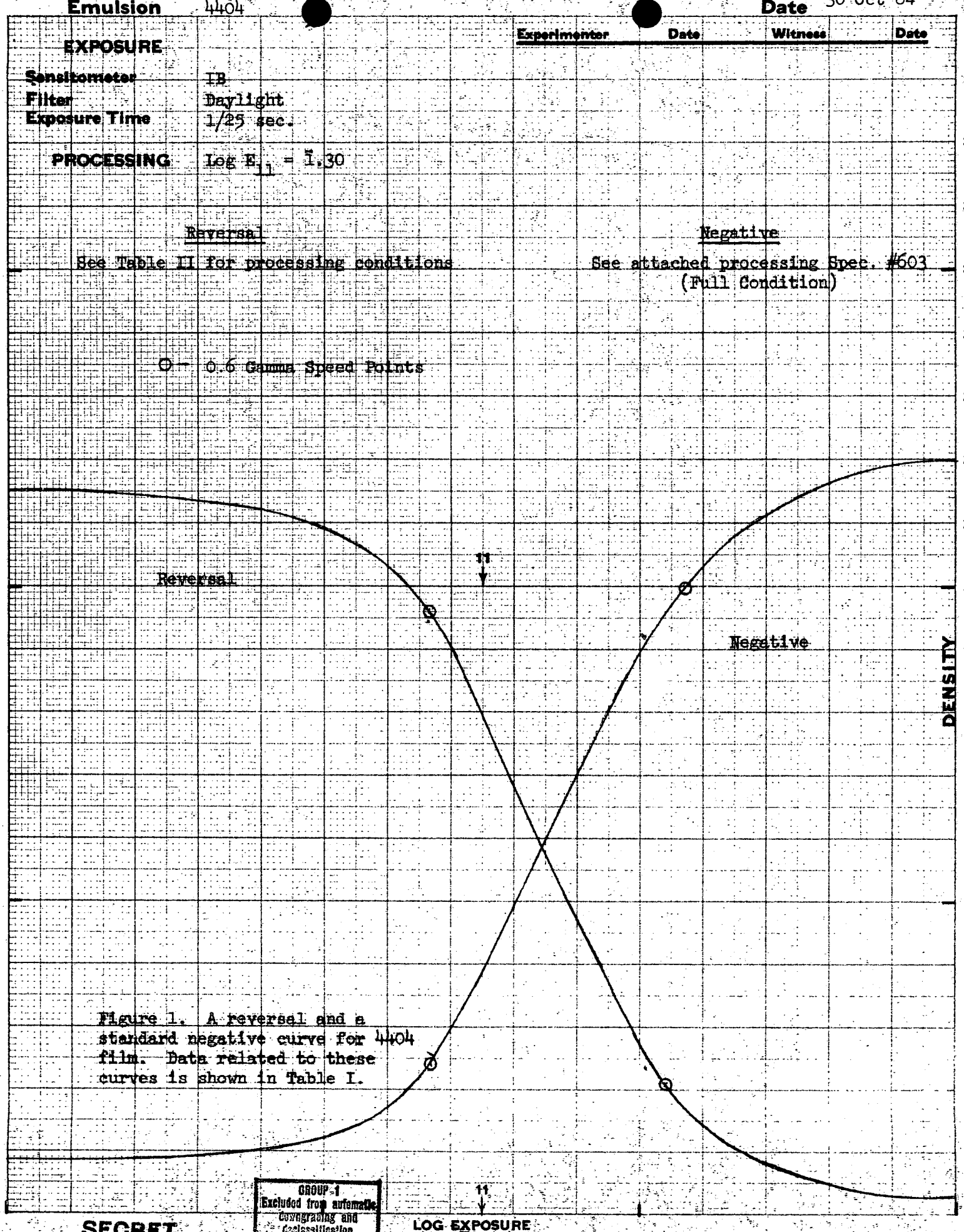

Figure 1. A reversal and a standard negative curve for 4404 film. Data related to these curves is shown in Table I.

SECRET

Fig. 1

SECRET

PAR 206

Emulsion 8430

Date 30 Oct 64

Experimenter Date Witness Date

EXPOSURE

Sensitometer IB

Filter

Exposure Time 1/sec.

PROCESSING $\text{Log } E_{11} = 1.38$

Reversal

See Table II for processing conditions

Negative

See attached Processing Spec. #600

O — 0.6 Gamma Speed Point

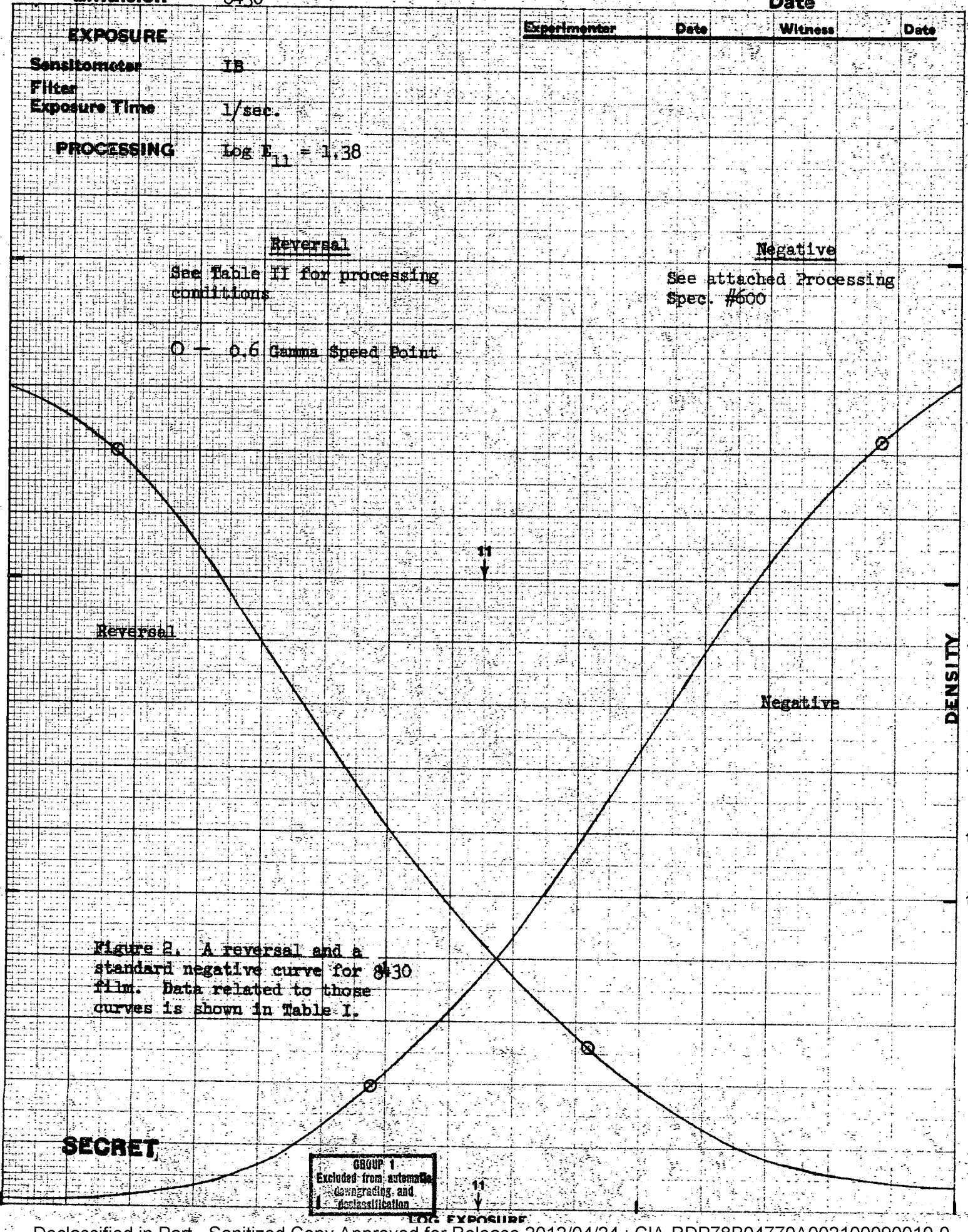

Figure 2. A reversal and a standard negative curve for 8430 film. Data related to those curves is shown in Table I.

SECRET

GROUP 1
Excluded from automatic downgrading and declassification

PAR 206
30 Oct 64

Characteristic Curve Parameters	Film Type and Processing Method			
	4404		8430	
	Negative	Reversal	Negative	Reversal
Gamma	2.20	2.14	1.49	1.40
Lower Speed Point	I.13	I.13	1.04	0.22
Upper Speed Point	I.94	I.88	2.63	1.72
SES (latitude)	0.81	0.75	1.59	1.50
Usable Density Spread	1.42	1.42	2.04	1.89
Absolute Dmin	0.18	0.07	.03	.08
Absolute Dmax	2.41	2.30	2.63	2.60

Table I A comparative listing of the important characteristic curve parameters of Figures 1 and 2.

Processing Stage	Film Type and Reversal Processing Conditions					
	8430			4404		
	Chemical	Time	Temp	Chemical	Time	Temp
1st Developer	MPE-101D	2'37"	75°F	MPE-111D	2'30"	75°F
Arrest	SB5B	30"	"	SB5B	30"	"
Bleach	R9-2	1'00"	"	R9-2	1'00"	"
Wash	H_2O	30"	"	H_2O	30"	"
Clear	CB-3	1'00"	"	CB-3	1'00"	"
Wash	H_2O	30"	"	H_2O	30"	"
Re-Expose	600 fcs	--	--	600 fcs	--	--
2nd Developer	D95	1'00"	75°F	D95	1'00"	"
Wash	H_2O	1'00"	"	H_2O	1'00"	"
Fix	F6	2'00"	"	F6	2'00"	"
Wash	H_2O	3'00"	"	H_2O	3'00"	"
Photo-flo	P-F	15"	"	P-F	15"	"

Table II Processing conditions on the sensitometric processor for films 4404 and 8430 to produce the sensitometric curves shown in Figures 1 and 2.

Table II

SECRET

PROCESSING SPECIFICATION NO. 600

DATE 5-19-64

MACHINE Dalton 3 & 4
PRODUCT Duce Pos & Neg.
EMULSION TYPE 8430
SIZE 70mm thru 9-1/2
PROCESS EMULSION UP ☞ DOWN ☜

MACHINE SPEED DIAL SETTING
FILM STRIP SPEED 60 ft./min.
SECONDS PER RACK
THREAD-UP Full Top of adj. rack set at 20.5

PROCESSING STAGE	CHEMICAL TANK	CHEMICAL RPL.	RPL. RATE (per min.)	TEMP.	TIME	NO. R.	PUMP PRESSURE	NOZZLE TYPE	AGITATION TYPE	AGITATION GAS	AGITATION PRES.
Developer	DD-691	DD-691	3000 mL[1]	71° ± 1°	24"		35 psi	K-1.5			
Hypo	F-6	F-6	1000 mL[2]	70° ± 2°	31"		20 psi	K-3			
Wash	H_2O	H_2O	8 Gal	70° ± 2°	31"		20 psi	K-3			
Photo-flo	P.F.	P.F.	200 mL	70° ± 2°	1"						
Dryer				90° ± 5°	21"						
Cond. Cabinet				82° ± 5°							

1. Increase to 3500 for 9-1/2

2. Increase to 2500 for 9-1/2

DAMPER SETTINGS:
INTAKE None
EXHAUST

VARIAC SETTINGS
LOCATION OR NO. OF VOLTS.
Feed carriage 2
Cond. cabinet 1
Take-off carriage 1/2

COMMENTS:
Dry cabinet heater selector switch - off
Dry cabinet reverser roller 6 psi
150 mls of KBR solution added to a fresh sump

SECRET

Table III

PAR 206

DATE 12/30/63

PROCESSING SPECIFICATION NO. 603

MACHINE Trenton #1 & #2
PRODUCT Negative
FILM TYPE 4404
SIZE 70mm
PROCESS EMULSION UP ___ DOWN X

MACHINE SPEED DIAL SETTING 25
FILM STRIP SPEED 25 ft. per min.
THREAD-UP Full - Skip
adjustable roller in full section

PROCESSING STAGE	CHEMICAL TANK	CHEMICAL RPL.	RPL. RATE	TEMP.	TIME	PRESSURE	NOZZLE TYPE
Primary	P-693	P-693	1500 ml	74° ± .5°	2'15"	15 psi	K3
Arrest	SB5B	SB5B	500 ml	70° ± 2°	4"	15 psi	K5
Wash	H_2O	H_2O	7 gal.	70° ± 2°	15"	5 psi	K5
Secondary	MPG-106D	MPG-106D	2000 ml	68° ± .5°	Int. 25" Full 1' 16"	15 psi	K3
Arrest	SB5B	SB5B	500 ml	70° ± 2°	3"	15 psi	
Hypo Rinse	F-6	F-6	1300 ml	70° ± 2°	24"	15 psi	K1.5
Hypo	F-6	F-6	1300 ml	70° ± 2°	1'19"	15 psi	K3
Wash	H_2O	H_2O	10 gal	70° ± 2°	1'40"	15 psi	K3
Photo-flo	P-F	P-F	200 ml	70° ± 2°	1"		
Dryer Cabinet				105° ± 5°	57"		
Condition Cabinet				95° ± 5°	1'25"		

DAMPER SETTINGS:
INTAKE None
EXHAUST Wide Open

VARIAC SETTINGS

LOCATION	OR NO. OF WGTS.
Feed-Carriage	1 1/2
Condition Cab.	1

COMMENT:
Dryer cabinet selector switch 1. Top spray nozzle on each header in primary section is turned up to break-up any developer run down.

GROUP 1
Excluded from automatic downgrading and declassification

Table IV

SECRET

MONTHLY REPORT

25X1

PAR 206

2 Oct 64

SUBJECT: Reversal Processing of High Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high-resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. The results of the Grafton experiments (see PAR 206 write-up in Quarterly Report No. 3 dated 5 June 1964) showed that additional testing was needed concerning the basic photographic properties of fine grain negative and duplicate films when used in a reversal process. Consequently, a laboratory investigation with a sensitometric processor was begun to determine the capabilities and shortcomings of these films.

3. The processor being used was designed specifically for this kind of testing. It has a low chemical usage rate, excellent temperature range and stability, variable agitation capability and is easily operated by one person. It consists of ten small removable tanks (about 1 gallon capacity each) arranged in a row and immersed in a constant temperature water bath. Agitation is provided mechanically by the back-and-forth movement of a flat rod through the solution. The travel speed of the rod can be changed to vary the agitation.

4. When testing is resumed on production type continuous processing equipment, any findings obtained with the sensitometric processor will be of more value with deep tank than with other type processors. However, regardless of the type of processor, some process investigations will be needed to correct for the particular conditions to be met.

5. The following films are being tested:

a. 4404 - Fine grain high resolution negative film.
b. 8430 - Fine grain high resolution duplicating film.
c. 4400 - High speed negative film.
d. SO-233 - Fine grain duplication film.
e. 7276 - Plux-X Reversal Film.*

6. Since conventional reversal films, by design, contain a much heavier silver layer and have a larger distribution in grain size than the films under consideration, it is expected that the latter will require some variations from normal reversal process chemistry and technique.

7. Tests are being conducted to determine the photographic effects caused by process changes in the first development stage. This is the most critical step of a reversal process since all of the others involve reactions which essentially go to completion. The areas being investigated are:

a. Time,
b. Temperature, and
c. Solvent concentration.

8. Figures 1, 2 and 3 are representative samples of the kinds of information collected. Figure 1 shows the effects of different solvent concentration in the first developer (a solvent is usually necessary in a reversal process to reduce the highlight density level). Time and temperature are held constant. Figure 2 shows the process effect of variations in the first developer temperature with the time held constant. Figure 3 shows the process effect of variations in the first development time with the temperature held constant.

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* Plus-X Reversal film 7276 was included in the test program for a general process check. Its characteristics are well known and, in this way, the other films could be compared to it to detect any general similarity in reversal processing effects.

PLANNED ACTIVITY

9. First developer testing will be continued. The effects of the following will also be investigated.

a. Bleach concentration, time, and temperature.
b. Clearing bath concentration, time, and temperature.
c. Re-exposing magnitude.
d. Fogging redevelopers.

10. Resolving power testing will be started as soon as a satisfactory process is obtained for any of the films being tested.

MONTHLY REPORT

PAR 206

2 Oct 64

25X1

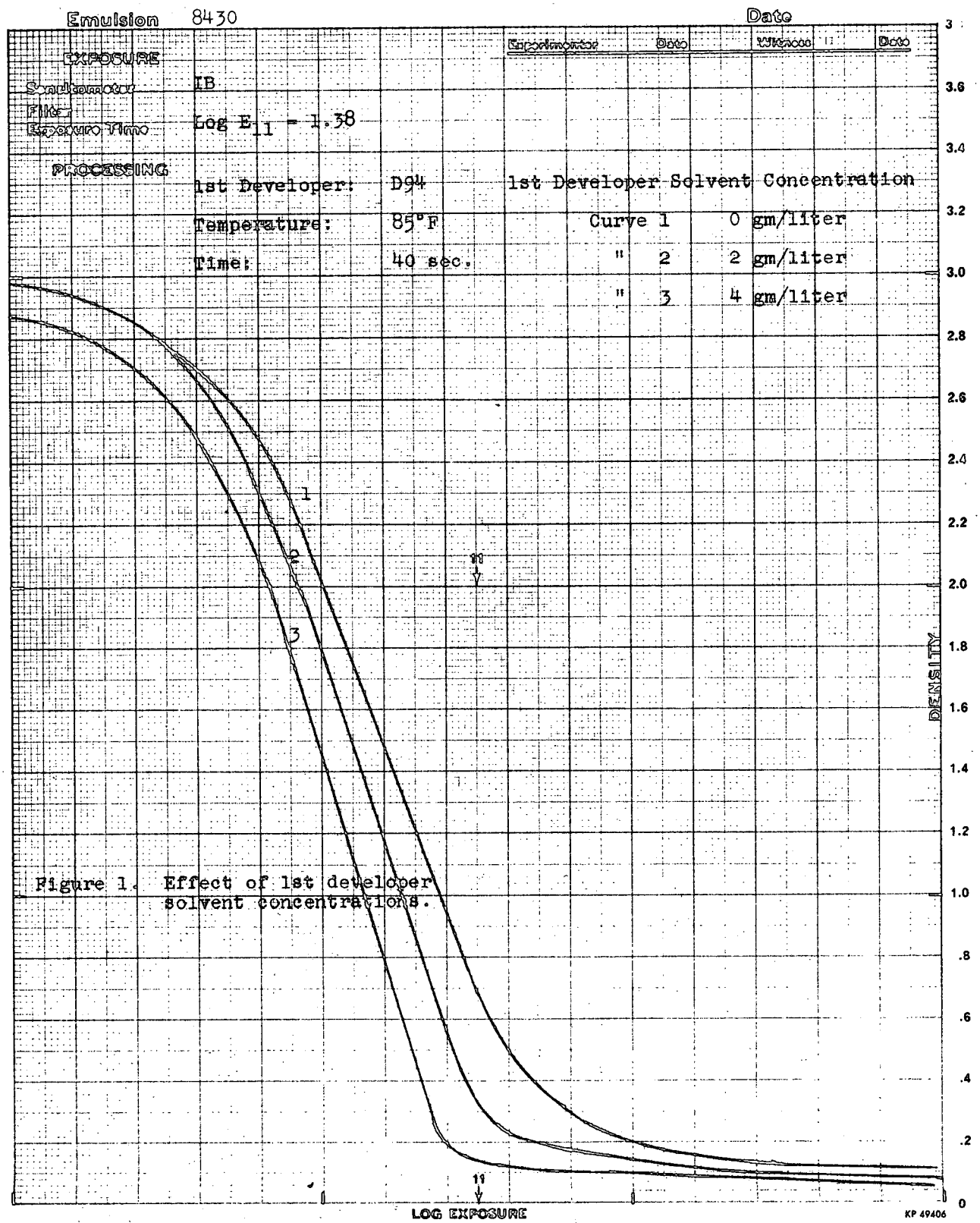


Figure 1. Effect of 1st developer solvent concentrations.

GROUP 1
Excluded from automatic downgrading and declassification

SECRET

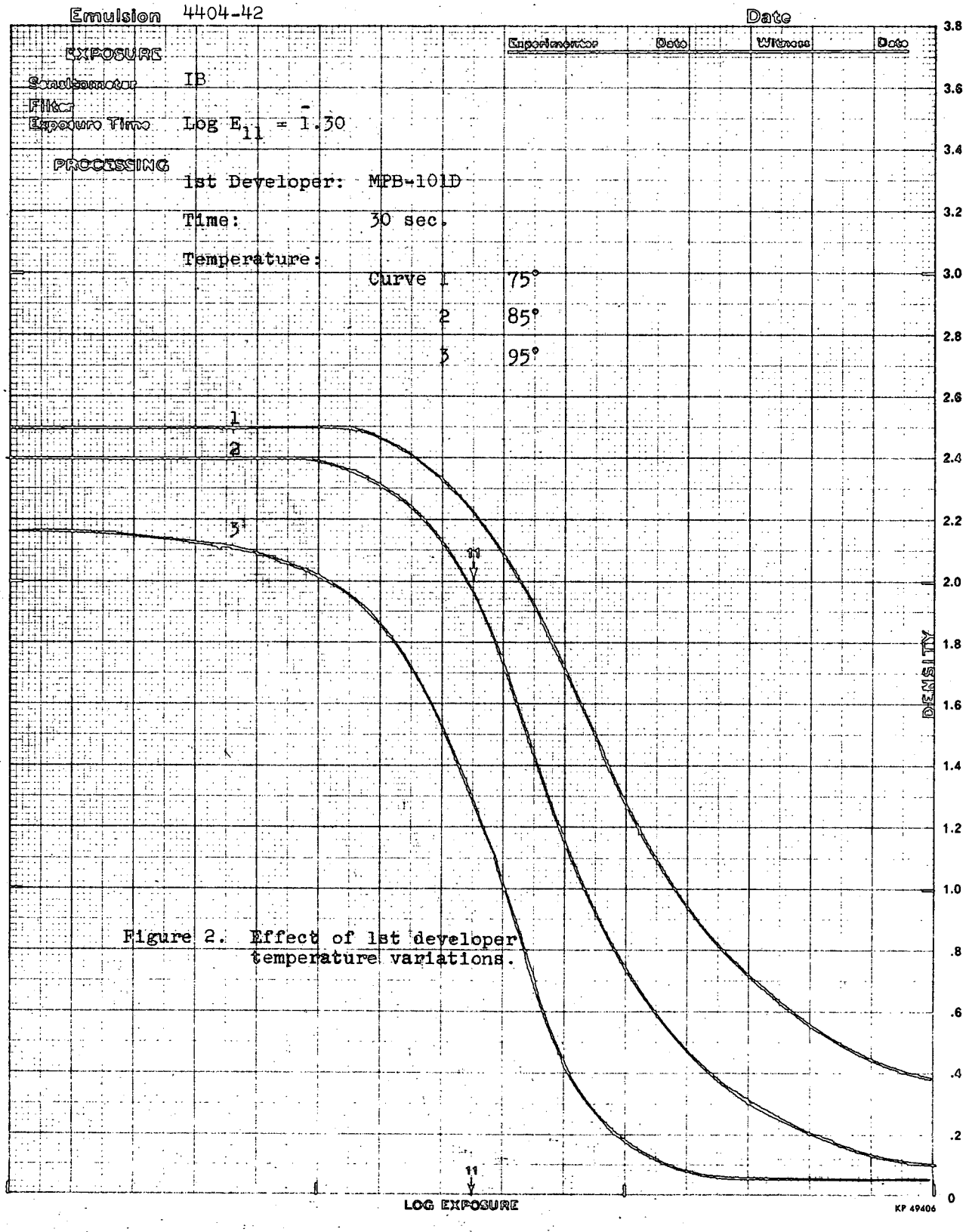


Figure 2. Effect of 1st developer temperature variations.

GROUP 1
Excluded from automatic downgrading and declassification

SECRET

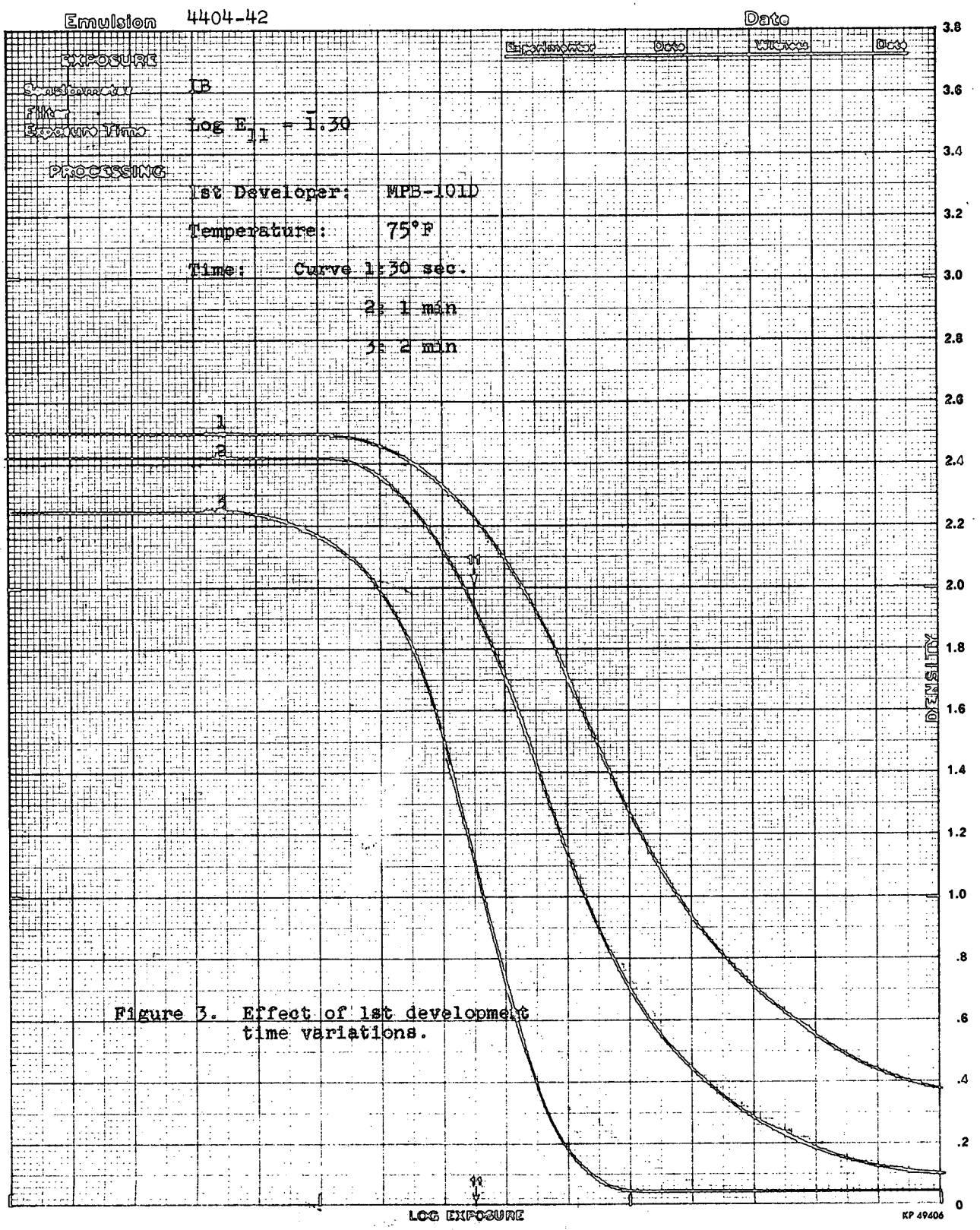


Figure 3. Effect of 1st development time variations.

PAR 206
8 Sept 64

SUBJECT: Reversal Processing of High-Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high-resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. An analysis of the results from the initial test program on the Grafton, as reported in a monthly report, dated 1 May 1964 showed that a new study plan was required. A plan for Phase I, Sensitometric Processor, was prepared, the main points of which are:

a. The film types 4400, 4404, 8430 and SO-233 will be tested.

b. Standard and modified reversal developers and conventional black-and-white developers will be used.

c. The photographic effects of the following will be determined:

(1) Chemical fogging agents.

(2) Variations of solvent concentrations in the first developer.

(3) Latensification with ultra violet light.

3. Phase II Grafton Processor: Starting points for a continuous process will be determined from the results of Phase I tests.

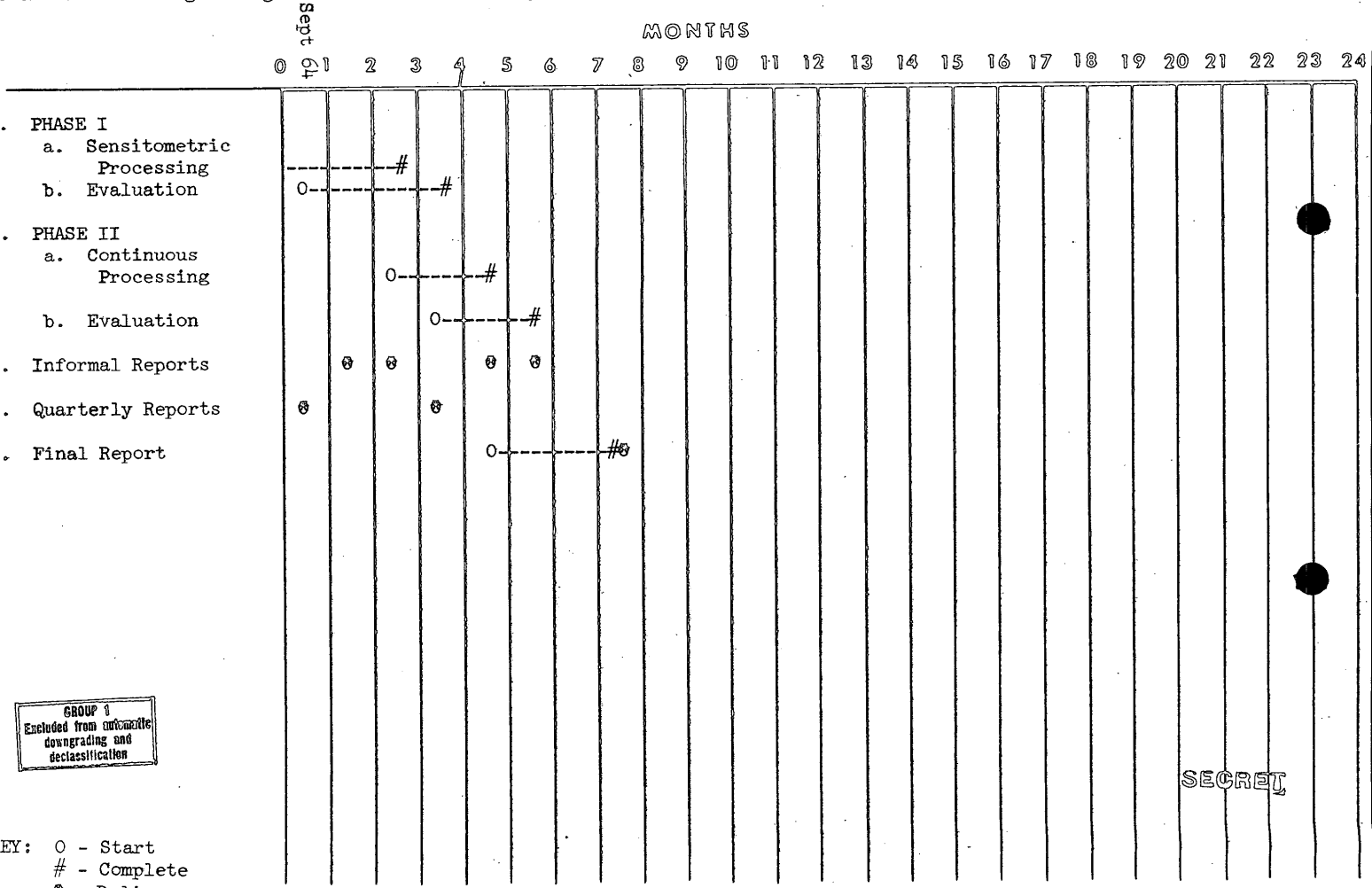
PLANNED ACTIVITY

4. The test program as outlined above will be initiated.

TENTATIVE SCHEDULE

PAR 206
1 Sept 64

Reversal Processing of High-Resolution Films Study



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MONTHLY REPORT

[redacted] 25X1

PAR 206

7 August 1964

SUBJECT: Reversal Processing of High-Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high-resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. The Grafton has not been available for work on this PAR nor will it be available in the immediate future. Therefore, work for the time being is restricted to the sensitometric processor. During the period a test program for this laboratory equipment was prepared.

PLANNED ACTIVITIES

3. Processing is planned on a sensitometric processor for the investigation of:

a. Chemical foggants.

b. First developer solvent concentrations.

c. Bleach concentrations.

d. The effect on the image of latensification with U.V. light through the film base.

4. The films used in the tests, will be 8430 duplicating film and 4400 and 4404 negative films. 7276 plus-X Reversal film will be included for process control purposes.

5. Briefing aids will be prepared to cover the major phases of this project.

SECRET

George

SECRET

MONTHLY REPORT

25X1

PAR 206

10 July 1964

SUBJECT: Reversal Processing of High-Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high-resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. Priority demands on the Grafton machine have continued through the subject period, and as a result, no processing tests were conducted. Activity has remained at a low level.

PLANNED ACTIVITY

3. During the period of machine unavailability there were some indications that sensitometric processing tests might be preferable to full scale machine testing. Because of these indications arrangements will be made for sensitometric tests.

4. Prior to sensitometric testing, investigations will be made to determine the best approach for an attack on the various problems of tone, contrast and fog level.

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Attachment #3
Rpt. Misc. - 35

26 June 64

SUBJECT: Quarterly Review Conference, PARs 206 and 207 - [redacted] 25X1

25X1 VISITORS: [redacted]

25X1 [redacted]

1. Due to the anticipated prolonged illness of [redacted] 25X1
25X1 [redacted] has assumed responsibility for PARs 202, 206, 214 and 215. 25X1
In view of this, review of these PARs by [redacted] is in the form of getting acquainted with the program.

2. PAR 206

25X1 a. [redacted] Contractor Engineer for PAR 206, was not available for discussion with [redacted] was informed that the 25X1
Grafton processor had been modified for reversal processing tests. [redacted] 25X1
was also informed that the only tests accomplished had been reversal by the re-exposure process. Tests show the contrast of the current reversal process for Type 8430 film results in a lower contrast reversal duplicate negative than in a corresponding third generation negative made from a duplicate positive.

25X1 b. [redacted] indicated the customer had considerable interest in the sensitometric differences and performance characteristics of reversal film which are chemically reversed.

3. PAR 207: Review of PAR 207 was delayed pending approval of PAR 207A submitted to the customer on 21 Apr 64.

25X1 [redacted]

DS:MSS

SECRET

25X1

PAR 206

5 June 1964

SUBJECT: Reversal Processing of High-Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high-resolution original negatives, duplicate positives, and duplicate negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. Conversion and mechanical shakedown of the Grafton was completed for black and white processing of Kodak Fine Grain Aerial Duplicating Film, Type 8430 and Kodak Special High Definition Aerial Duplicating Film, Type SO-105. These efforts covered:

a. Rotometer calibration.

b. Flow rate adjustments.

c. Spray nozzle adjustments.

The conversion was done in 20 hours. Future changeovers will be possible in less than half of this time and will include both mechanical and chemical conversion.

3. Forty-five sensitometric tests were run and, based on the results, about 4,000 feet of 70mm and 9½ inch prints (Type 8430) were processed for comparison with current production counterparts. Photographically, the process uniformity was found to be excellent. A summary of the process data follows:

a. Process temperature is 90F for the entire system.

b. A pre-wet bath is necessary to prevent mottle.

c. Second developer time is not critical after 30 seconds.

d. The first developer time is critical for variations of over 5 to 6 seconds.

e. One bank of printer lights is sufficient.

f. Process speed is 12½ feet per minute.

g. Drying temperature is 120F.

h. System gamma is about 1.10.

i. Increased replenisher rates will be necessary for the clearing bath.

4. Photographic results were as follows:

a. Resolution tests of Type 8430 processed on the Dalton show resolution of 396 lines/mm. Grafton reversal processed Type 8430 has 317 lines/mm. These were both second generation tests.

b. The reversal process demonstrates a brown tone compared to the sepia tone of the Dalton. Further the contrast of the reversal process is 1.25 compared to the Dalton process of about 1.48. The brown tone and lower contrast both contribute to lower resolution.

5. The conclusions reached:

a. Better tone can be gained by further chemical adjustments such as the use of a solvent in the first developer.

b. Higher contrast by adjustments in the two developers.

6. The typical sensitometric curve generated to date on the reversal process indicates higher fog than desirable. See attached curves of standard Dalton process, Figure 1, and Grafton experimental reversal process, Figure 2.

7. Priority demands on the Grafton have made it unavailable for this project recently and this has resulted in temporarily low activity. Activity is expected to increase in the coming quarter.

PLANNED ACTIVITY

8. Improvements will be considered for the following:

a. Lower drain for the printer housing was converted to remove residue chemicals and prevent resulting dust particles. This dust causes film spotting by desensitization or from inhibiting the re-exposure.

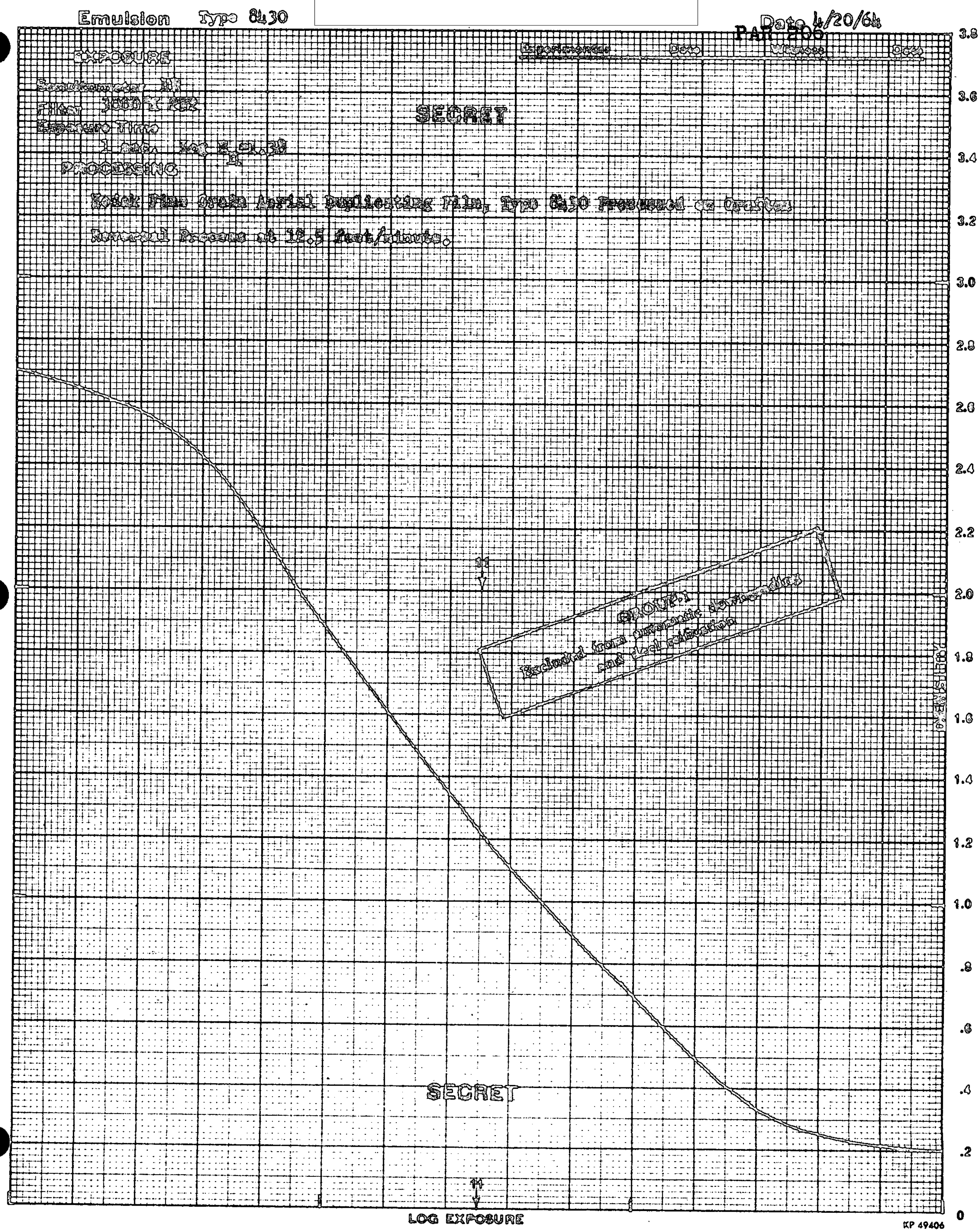
b. Better cover design for the spray section. It should be stronger, easier to install and prevent leakage.

c. Replacement of the squeegee roller with a pacer roller for better tracking.

9. Assessment of all test phase data collected thus far is planned to determine the courses of action most favorable for accomplishing project goals.

10. Laboratory sink testing of developer formulations to increase process contrast and improve tone quality will be carried out before full scale machine tests are resumed.

25X1



25X1

Emulsion Type 8430

Date 7/3/63

PAR 206

Experimenter Date Witness Date

EXPOSURE

Sensitometer X-B

Filter 3000°K 2#2

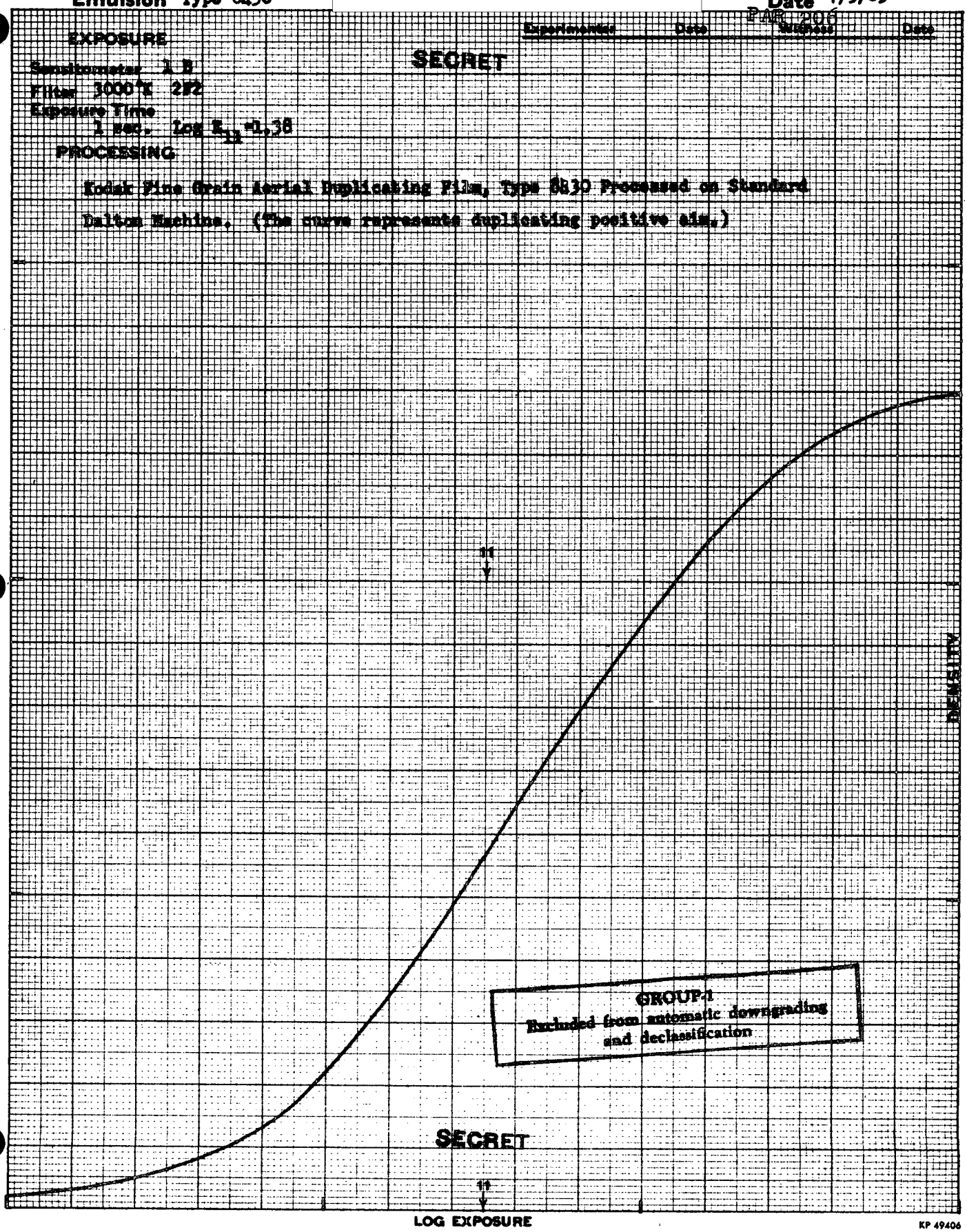
Exposure Time

1 sec. $\log E_{12}$ =1.38

PROCESSING

Kodak Fine Grain Aerial Duplicating Film, Type 8430 Processed on Standard Dalton Machine. (The curve represents duplicating positive film.)

SECRET



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MONTHLY REPORT

25X1

PAR 206
1 May 64

SUBJECT: Reversal Processing of High-Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high-resolution original negatives, dupe positives, and dupe negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. The Grafton was converted from a color system to black and white system. Because this was the first attempt, the change required 20 hours instead of the planned 8 hours. This initial effort however, included rotameter calibrations for the new chemical system. This step will not be necessary every time. It appears that a conversion time of 8 hours (includes both mechanical and chemical) will be possible.

3. The initial test series (mechanical shake-down) required many adjustments of spray nozzles and flow rates. Mechanical improvements that are necessary on a long-range basis are:

a. Drain the printer housing at its lowest point. Standing chemicals dry out and the resulting residue is chemical dust particles which cause spots on the film by (1) preventing re-exposure or (2) desensitization, thus affecting second development.

SECRET

b. Improve the cover design for the spray section. The present cover is structually weak, it permits chemicals to leak down outside machine tank walls, and it is hard to install and remove in event of spray section trouble-shooting.

c. Consider a new pacer roller arrangment. Use of the squeegee roller on the pacer roller causes poor tracking. (This was found true for color materials as well).

4. Photographically, the process uniformity is excellent. Streaks were observed and isolated as being in the emulsion (Type 8430). A total of 45 sensitometric tests were run. In addition, based on the results of the tests, about 4000 feet of 70mm and 9 1/2-inch (Type 8430) prints were processed for comparison with current production counterparts. A summary of the data follows:

a. The process temperature is 90F for the entire system.
b. A pre-wet bath is necessary to prevent mottling.
c. The second developer time is not critical after 30 seconds.
d. The first developer time is critical to variations over 5 to 6 seconds.
e. One bank of printer lights is sufficient.
f. Process speed is 12 1/2 feet per minute.
g. Drying temperature is 120F.
h. System gamma is about 1.10.
i. Increased replenisher rates will be necessary for the clearing bath.

PLANNED ACTIVITY

5. To assess all data collected from this initial test phase, and determine probable courses of action for improvement.

6. The processor will not be available for further reversal effort for about two to three weeks effective 23 April 1964.

6a

SECRET

MONTHLY REPORT

25X1

PAR 206

3 Apr 64

SUBJECT: Reversal Processing of High-Resolution Films Study

TASK/PROBLEM

1. Investigate and develop a reversal process for high-resolution original negatives, dupe positives, and dupe negatives. Process to accomplish reversal with minimum loss of resolution.

DISCUSSION

2. Plumbing and mechanical changes to the Grafton have modified the processor so it now is capable of black-and-white reversal processing of Type 8430 and SO-107 films.

3. A tray-process test, which was made in search of a suitable reversal duplicating film proved that Kodalith Duplicating Film is unsatisfactory. All test samples contained extreme contrasts with a high degree of loss in information content in both D-Min and D-Max areas.

PLANNED ACTIVITIES

4. The initial testing phase of the machine reversal processing will be started 1 Apr 64.

SECRET

25X1

PAR 206

29 Feb 64

SUBJECT: Reversal Processing of High-Resolution Films Study

TASK/PROBLEM

Investigate and develop a reversal process for high-resolution original negatives, dup positives and dup negatives. Process to accomplish reversal with minimum loss of resolution. Selected process should accomplish reversal with no more loss of resolution than that now experienced from original negative to the first generation dup negative.

DISCUSSION

Process systems and test planning phases have been outlined. Application of plans are being held in abeyance until present in-house equipments can be converted to test each process being investigated.

PLANNED ACTIVITIES

During the next quarter primary effort will be aimed at developing a reversal process for film Type 8430 on the Grafton processor.

After Type 8430 has been completely evaluated, the program will then be continued on other selected film products.

6 Dec 63

STUDY PROGRAM OBJECTIVE

Reversal Processing of High Resolution Positive Films for Duplicate Negatives (PAR-206)

Problem

Currently large numbers of duplicate positive copies are made directly from the original negative requiring multiple use of the original. This increases the chances for loss of quality in the original negative through abrasion, digs, kinks, dirt, etc.

There is also a demand for duplicate negatives so that customers can make additional copies and enlargements for specialized uses. The production of such negatives normally requires two printing steps which can increase the information loss.

A third problem arises in locations where positive prints are wanted and only a positive is available as a printer master. In this case the reversal processing of high resolution print film greatly simplifies the problem.

Proposal

We propose to investigate the reversal processing of high resolution positive films in order to achieve the following goals:

1. Production of a "master duplicate negative" directly from the original negative by reversal processing; then using this negative for the printing of the many duplicate positives used in the community.

2. Improvement in the quality of the duplicate negatives by reversal processing. These reversal negatives can be disseminated to others for further reproduction or exploitation as required.

3. Reproduction of a positive from a positive or a negative from a negative if required without loss inherent in two printing-processing cycles or generations.

Because such degradation of dirt, scratches, etc. and loss of resolution is particularly evident and critical in today's high acuity taking films we propose to initiate our investigation with the reversal properties of fine grain duplication films such as Type 8430 (or even finer grain products).

Such films will be examined from the point of view of their characteristics both physical and photographic. Experiments will be performed with the developer chemistry and with developer techniques to

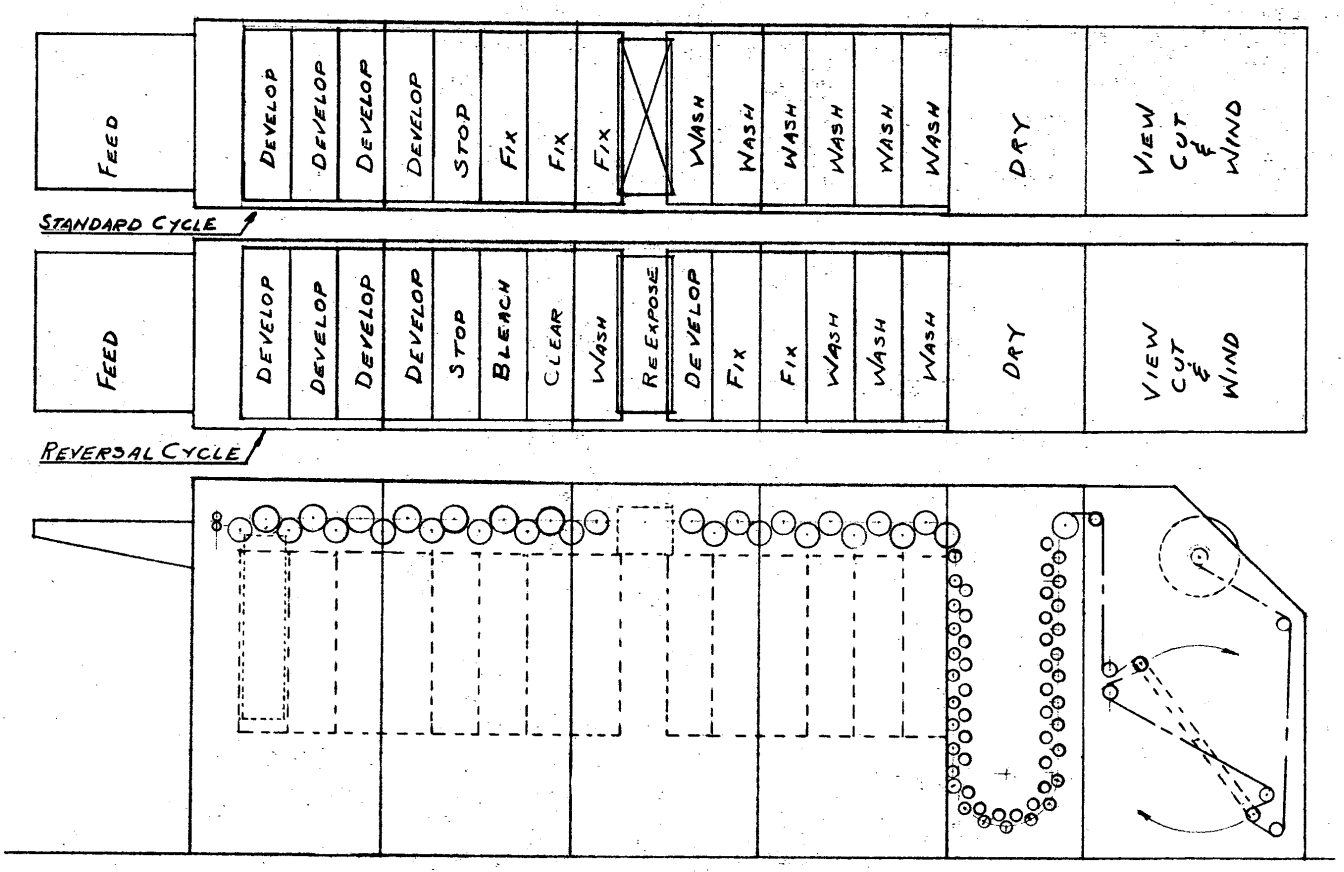
determine the optimum combination for each film.

Results will be analyzed to determine what effect taking scales and taking film information content have on the validity of the reversal concept. We foresee that large scale, low resolution negatives may not warrant the added complexities of reversal processing in view of the present printer capabilities. At the other end of the scale it is entirely possible that any printing technique will result in a loss of information. Under such conditions the solution may well be to enlarge the negative immediately by the best possible means and then utilize the resulting "master" dupe negative produced by reversal processing for duplicating other requirements.

Sensitometric exposures, resolution charts and typical aerial images will be exposed on Type 8430 Fine Grain Duplicating Film and other fine grain duplicating films which may be available. These exposed films will be processed using reversal processing techniques.

These techniques will include evaluation of both optical and chemical processing methods for reversal of the photographic image. These films will be evaluated for excellence in providing maximum information and tonal reproduction. Where needed alterations in the reversal processing machine or in the reversal processing chemistry will be made to achieve optimum physical and photographic performance.

Trade trials will be made using the reversal processing technique. These examples will be distributed to the community for their evaluation.



SPEC No 203

FIG. - 1